

## IMPLEMENTATION OF THE SYSTEMIC APPROACH IN TEACHING AND LEARNING BIOCHEMISTRY IN ALBANIA

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### ABSTRACT

Though newly introduced, global education has occupied a special place in the glossary of teaching. It props up both the teachers and students to have a broad view of the problems and issues and think constructively of the future and their role in modeling it. In this respect, teachers need to consider themselves as global citizens and take all the responsibilities that accompany the phenomenon of globalism. At the same time, teachers must regard themselves as members of their community. The main characteristic of teaching in the framework of global education is the partnership between the teacher and the student which finds itself expressed in the methods and numerous interactive techniques and constitutes its content. The teachers who keep teaching by employing traditional methods find it difficult to promote the active role of the students in the classroom, see the relationship of their subject they are teaching with others, and perceive the prospective of their teaching. The philosophy of global teaching integrates exactly those elements which the traditional method lacks. The focus of the philosophy of global education is the student and teaching. These days we live in a society which is constantly becoming essentially globalized and fundamentally affected by both decisions made irrespective of our will and events that take place far from us. Consequently, we are constantly under the pressure of global, cultural, social, economic, technologic, and environmental tendencies as well as changes which come about very rapidly. Therefore, it is our duty and that of the entire society to increase students' ability to think systematically in order that they could be able to face this ever globalizing world, think constructively of their future and the role they are to play to shape it, and learn from the past. Methodology provides students and lecturers with a global image of the teaching of science. As is known, teaching is carried out through communication. Teaching all over the world is adopting this method. Learning process becomes pleasant if better communication skills of the teacher prevail upon the inherent inertia associated with the students, while they focus upon a difficult subject. This way of teaching is increasingly being highly appraised by the world academy. *[African Journal of Chemical Education—AJCE 7(3), Special Issue, October 2017]*

## **INTRODUCTION**

Global education is an education perspective which arises from the fact that contemporary people live and interact in an increasingly globalized world. This makes it crucial for education to give learners the opportunity and competences to share their own point of view and reflect upon their role within a global, interconnected society, as well as to understand and discuss complex relationships of common social, ecological, political and economic issues, so as to develop new perspectives.

Biochemistry is a multidisciplinary science and as such a hard subject to learn. Teachers should use various methods to assist students to study this subject [1, 4]. This science focuses on the study of the structure and the dynamics of the significant cell components, metabolism of substances and concludes with protein synthesis. Students should not only study the structure and the function of the cell components, but also understand the relationship between concepts in a wider context.

Biochemistry studies chemical processes which occur in the living organisms. Just like machineries, the living organisms, based on the laws of energy conversion, by means of metabolic processes, acquire energy from food diets (proteins, carbohydrates, lipids). The cell “spreads” the energy it acquires to perform chemical operation (biosynthesis), mechanical operation (muscle contraction), and osmotic operation (active transport). These metabolic processes take place inside the cell but in different organelles. Just as organelles are tied up in the cell, so are metabolic processes linked to each other [15].

For this reason, concepts have been explained in detail in a very simple language to be understood and acquired to an optimal degree. In his way, teachers can make biochemistry attractive and not boring for students. Methods and teaching techniques are standard procedures

used by the lecturer in his/her interaction with students to introduce teaching materials and teaching activities in order to reach goals and teaching objectives [7, 17].

Of the diversity of the methods, the lecturer should choose the one that makes teaching more efficient, more compelling, more informative, more varied and more interesting. There are several strategies that make teaching and learning much easier and understandable; the most important strategy is the systemic one which interlinks the lecturer, the student and the environment [45].

The systemic approach in teaching and learning is a new one and is contrasted to the common approach of the concept map which involves the creation of a hierarchy of concepts (9). The systemic approach creates a somewhat closed system of concepts, a cluster concept that highlights interrelations. This method contradicts the linear method which is currently used in the educational system. The technique of the systemic approach in teaching and learning is a good instrument to increase the communicative skills of the teacher [30].

The organization of the lesson by employing the systemic approach in teaching and learning is unique in itself. In essence, the systemic approach includes offering of facts, concepts and skills, all in one unit. In this age, in the 21 century, it is indispensable for us to shift from the linear educational system to the systemic educational system [32].

Systematic approach is an orienting, restructuring means which asks for the explanation of the subject matter by both the student and the teacher through the creation of a diagram about the strategy of the map of concepts [10]. Educating students with materials and approaches to understand such linear processes does not help them to cope with the developing global environment [33].

Accordingly, the development of a systemic approach to teaching and learning (SATL)

treats subjects from an integrated and global viewpoint with the expectation that students would benefit from this approach when they enter the global world society [14]. In contrast with usual strategy concept mapping which involves establishing a hierarchy of concepts, this approach creates closed-cluster of systemic concepts, which help students concentrate on interrelationships and provides them with a global view of the subject (as displayed in figure 1) [8].

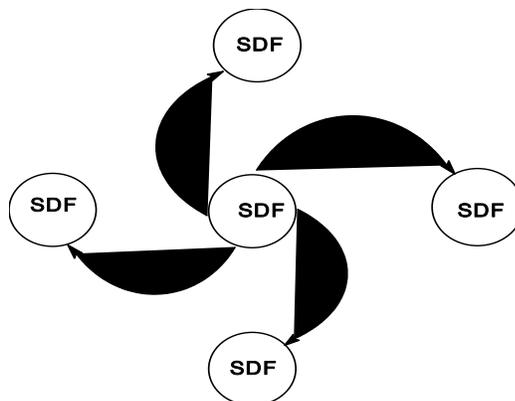


Figure 1. Systemic diagram representation.

### What are some characteristics of this method?

The following are certain characteristics that typify the Systemic Approach.

- Systemic approach in learning and teaching chemistry (SALT), is a method that has found application in all fields of science. It is related to the names of two professors, Fahmy and Lagowski, who gave a global vision to teaching and learning chemistry, and constitutes one of the most significant characteristics of globalism.
- SATL contradicts the linear method which is currently used in the educational system. This method contests the linear approach and has found wide acclaim nowadays. It is the teachers' responsibilities to train their students to think systemically, a characteristic of globalism [26-29]. In this way teachers can ensure effective teaching.
- (SATL) methodology is holistic in essence and encompasses delivery of facts, concepts

and skills in one package [23].

- SATL is a new way of teaching and learning, based on the idea that nowadays, anything is related to everything globally, In view of this method concepts and facts are interrelated and arranged in a systemic relationship. Students shouldn't learn isolated facts (by heart), in contrast, they should connect concepts and facts in a logical context and stress the relationships among concepts. In this context, "systemic" means arrangement of concepts or issues through interacting systems where all relationships between concepts and issues are made clear to the learner [9]. In this process, significant learning interactions occur between learners, learners and teachers, and learners and the context.
- Systemic Approach in Teaching and Learning is a means of orientating and restructuring. It demands that teachers' information be oriented by the strategy of the map of concepts.
- The general strategy of this method has been based on the collection, systematization and presentation of the map of concepts through the interactive system which all who study refer to, in order that they could have their concepts and issued clarified.
- SATL-based-learning is an active process where learners are encouraged to discover principles, concepts, and facts and arrange them in a systemic relationship.
- The systemic approach in teaching and learning is a new approach contrasted to the common approach of the concept map which involves the creation of a hierarchy of concepts. The systemic approach creates a somewhat closed system of concepts, a cluster concept that highlights interrelation.

### **What is the instructor's role in this method?**

The role and knowledge of the teacher are both very important and irreplaceable. The main roles the teacher should adapt when applying the Systemic Approach are the following:

- Organizer
- Leader
- Partner in communication and interaction
- Motivator
- Evaluator

## **METHODOLOGY**

My work presents the application of the systematic method in the lectures, seminars and exercises in the courses of biochemistry, medical biochemistry and the biochemistry of the physical activity that I teach by building a systematic diagram. The method has been applied at the University of Shkodra “Luigj Gurakuqi”, (Albania) in the Faculty of Natural Sciences, at the Department of Biochemistry with the students of the first study degree (BA), in the subject of biochemistry since 2007.

Students were divided into two groups at will. The first group acted as an experimental group whereas the second operated as a controller. The lecturer provided both groups with the necessary explanation. The experimental group has learned by using the systematic method whereas the control group the linear method. Two exams were organized, one before method application, the other after its application. The exams incorporated linear and systematic questions for both groups. The best assessment acquired 100 points; the minimum passing assessment was 35 points. The number of the students who were involved in the study was 2350, of which 1320 were involved in the experimental group and 1030 in the control group. The study lasted for ten years and was focused on:

- Systematic application of the method in biochemistry courses (General biochemistry,

Medical biochemistry, Clinical biochemistry and Biochemistry of the physical activity.

- Systematic evaluation
- Types of systematic questions
- Systematic link between the categories of thinking
- Systematic link between fields of knowledge

### **Systematic application of the method in biochemistry courses**

Of the diversity of the methods, the lecturer of the biochemistry courses, (General Biochemistry, Medical Biochemistry, Clinical Biochemistry and Biochemistry of the physical activity), should choose the one that makes teaching more efficient, more compelling, more informative, more varied and more interesting [6]. Methods and teaching techniques are standard procedures used by the lecturer in his/her interaction with students to introduce teaching materials and teaching activities to reach goals and teaching objectives. There are several strategies that make teaching and learning much easier and understandable; the most important strategy is the systemic one which interlinks the lecturer, the student and the environment objectives [23].

One form of the organization of the teaching process is the teaching unit which constitutes the essential unit. Changes in the way of organizing the teaching unit intend to increase the yield and the quality of the teaching process.

The construction of the teaching unit according to the linear method of teaching is based on the transfer of the information step by step to the students, who can afterwards, relate it to their previous knowledge. The teaching unit encourages memorizing, however, in some way, it prohibits the creativity which is very important for their future [31].

**Building a systematic diagram in biochemistry courses**

The main structural element of the SATLC method is the systemic diagram which bears all the attributes of a closed map of the concept [10]. Systemic Approach in Teaching and Learning (SATL) methodology is holistic in essence and encompasses delivery of facts, concepts and skills in one package. Teaching is carried out through communication. As mentioned above, learning process becomes pleasant if better communication skills of the teacher prevail upon the inherent inertia, associated with the students, while they focus upon a difficult subject (35). SATLC technique is a better instrument for making the teacher's job easier, as it amply enhances the communication skills of the teacher [41].

With this method, the teaching process has two basic qualities, the indirect student-knowledge interaction, elaborated didactically from the lecturer and the direct knowledge interaction.

The SATL lesson would require a multi-step progress [9]. This diagram, the SD1 (initial systemic diagram) represents students' knowledge acquired from other subjects related to biochemistry [15]. SD2, SD3 and SDF (final systemic diagram) signifies students' achievement during the module teaching. In the SDF diagram, all links between concepts, metabolic cycles, cell organs and body organs are familiar and well clarified (as displayed in figure 2).

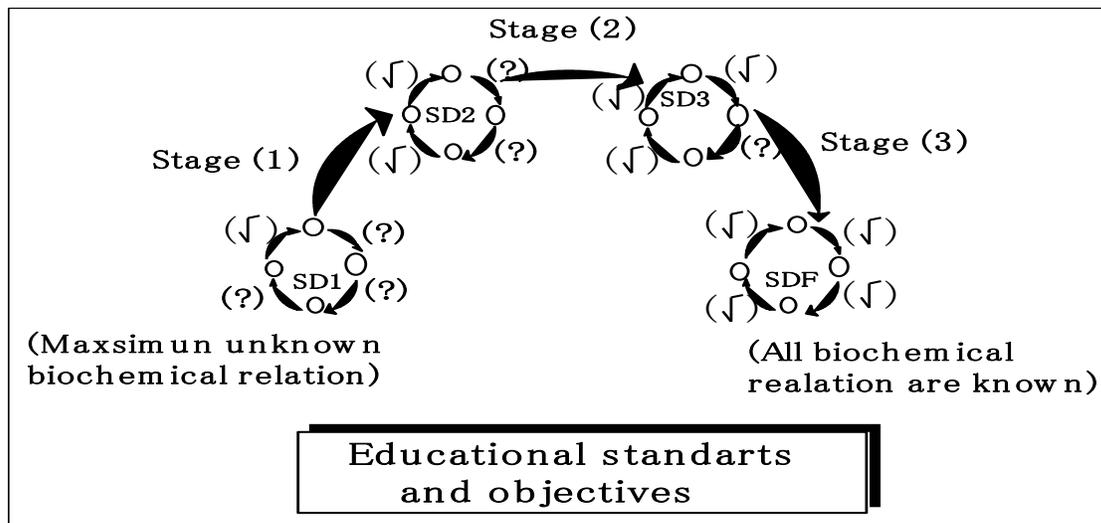


Fig 2. Building systemic diagram

## SYSTEMIC TEACHING STRATEGY

The benefits of this systemic diagram (SATL) are:

- The technique of the systematic unit is a very helpful instrument to make the teacher's job easier and to ensure that students receive good information. Besides, it offers the core of systematic thinking and ensures the continuous increase of knowledge which is in itself a sign of qualitative education [15, 16, 22, 23, 31, 34].
- The construction of this systemic diagram is multi-step structure and consists of content requirements, content development, and use. The material is divided into levels of detail, so that the student studies until he has reached the level he needs. At each level of detail, the material is treated as a whole, then, it is split in parts, and finally it is recombined into a functional whole.

### **Systematic link between categories of thinking**

Textbooks and teachers of biochemistry have excessive information available. This big quantity of information may affect the explanation of concepts. It can be said that the student thinks systematically if he/she is capable of:

- systemizing concepts, i.e. ranking them in a logical order,
- distinguishing and providing the relationship between categories of thinking in favor of teaching that develops thinking,
- thinking effectively by avoiding mechanical thinking.

The systemic approach in teaching and learning promotes higher levels of thinking, which means, evaluating, analyzing and synthesizing. This way of thinking constitutes one of the most important characteristics of globalism because it increases student's ability to find the main solution to problems. In this way, students' capacity to think systematically is improved and their creativity is increased.

The three categories of thinking have been defined as basic criteria in the field of education. They act simultaneously and in an integrated way, which means, they act through the interaction of creative thinking, critical thinking and problematic thinking [27]. Emphasizing the systemic connection in these categories is an outcome of the understanding that a technologic modern society cannot be created without people that understand changes, use information, analyze problems, know how to create and value the solutions.

These findings are of special importance and serve as a message for teachers who are required to use both hemispheres in teaching and learning. This orientation is bears specific significance for the traditional teacher and the schools in Albania where the use of the left hemisphere predominates over the use of the right one, whereas both are less frequently used.

This model demonstrates sparse interaction of the actual fields of teaching. To reveal the relationship of different types of thinking, the systematic diagram can be employed [30]. This diagram shows that the critical, creative and problematic zones are components of thinking and communicate with each other, when creative thinking occurs, critical and problematic thinking cannot be excluded from the process. Hence, just as creative processes predominate in the human brain, so do the critical and problematic ones. Lecturers should integrate the various categories of thinking. They should not put emphasis on one at the expense of the other.

The analysis shows that thinking processes at all levels of education should be improved. For this reason, strategies of teaching and learning methodology which allow for the development of thinking skills and the process of different types of basic thinking should be used at all levels of education. Strategies of the teaching and learning methodology help students to think more and better in order that they could be able to give solutions to problems and think effectively. They will be successful if their systemic relationship can be achieved.

### **Systematic questions**

A very important element of the teaching planned is the evaluation of students [37]. Evaluation should be very objective and supported with data. A necessary condition for this kind of evaluation is the way that you make up questions. Such innovation provides systematic evaluation, which is based on the systematic diagram. Testing plays an important role in this system. The objective test is created in a way that a different estimator who assesses independently will achieve the same results for the introduced level of knowledge and abilities based on true answers. In comparison with the traditional objective test, the systemic objective test includes many demands that are completely structured; it covers a huge part of the educational schedule,

and measures high levels of education (synthesis, analysis and estimation). In chemistry, the systemic objective tests (SOT) are prepared and experimented by Prof. A. F. M. Fahmy and Prof. J. J. Lagowski, the founders of the systemic method in teaching and learning chemistry (SATLC). Asking questions is a practice that does not only serve to know who the student that knows the answer is, but also contributes to making the student more competent, capable of finding the right answer through different ways [45].

Nowadays, questioning is not as it used to be in the traditional teaching, where only the teacher used to ask; it's a mutual process between the teacher and the student. The first thing that they have to do is to set the criteria to support their judgment and the second one is to judge by using these criteria. Construction of systemic questions requires the realization of some requirements such as:

- Determining the types of relations between the given concepts,
- Determining of the size of the building of systemic diagrams,
- Putting the arrows in relationships between concepts or facts,
- Directing the arrow head clockwise or anticlockwise,
- Providing the information in the stem and keeping the options clear and systemic,
- Putting the information in the stem to make the problem clear & specific.

Different tests, such as STFQs, SMCQs, SSQs, ASQs, and SCQs, as examples of the systemic objective test in biochemistry, have been presented in my articles [25.36]. Geometric shapes are different. They are triangular, quadrilateral, pentagonal, hexagonal, and so on, depending on the number of the concepts that are incorporated in the diagram. Systemic-learning-based test, presently known as systemic objective test (SOT), could be an instrument for determining the scale of learning level, that is, analysis, synthesis and evaluation.

The benefits of this new positioning are:

- Students develop skills and abilities to recognize problems and participate in their solution.
- Students use their critical thinking, problem solving and decision making abilities.
- Students demonstrate self-management skills.
- Students have a deep critical thinking for the problems that occur.
- Students organize their thinking in the process of systematic diagram completion.
- Students complete difficult systematic diagrams through systemic thinking. They improve their perception by increasing their observation skills.
- Students learn through creation and not through reproduction, therefore, they increase their creativity.

## RESULTS

The results of students' performance in the exams and their elaboration have been displayed in the figures below. Figure 3 shows students' results before and after the exams of both groups. Graphs have been drawn to display the percentage of the students' average scores on examination.

The points before the exam have been displayed on the left hand bar of each couple of graphs, whereas the points of the exam after the application of the methods have been displayed on the right hand bar.

Figure 3 displays the distribution of the scores of students of the experimental group and those of the control group after the application of the SALT. The highest frequency for the experimental group occurs in area of the 65-80 points, whereas the highest frequency for control group occurs in area of the 30-40 points.

Therefore, the comparison shows that the experimental group clearly achieved a higher level as measured by the total average score of the examination for the 10 years altogether (as displayed in figure 1). Figure 3 shows the success of the systemic approach to teaching organic chemistry established by using two groups; the experimental group, which was taught systemically, and the control group, which was taught in the classical linear manner.

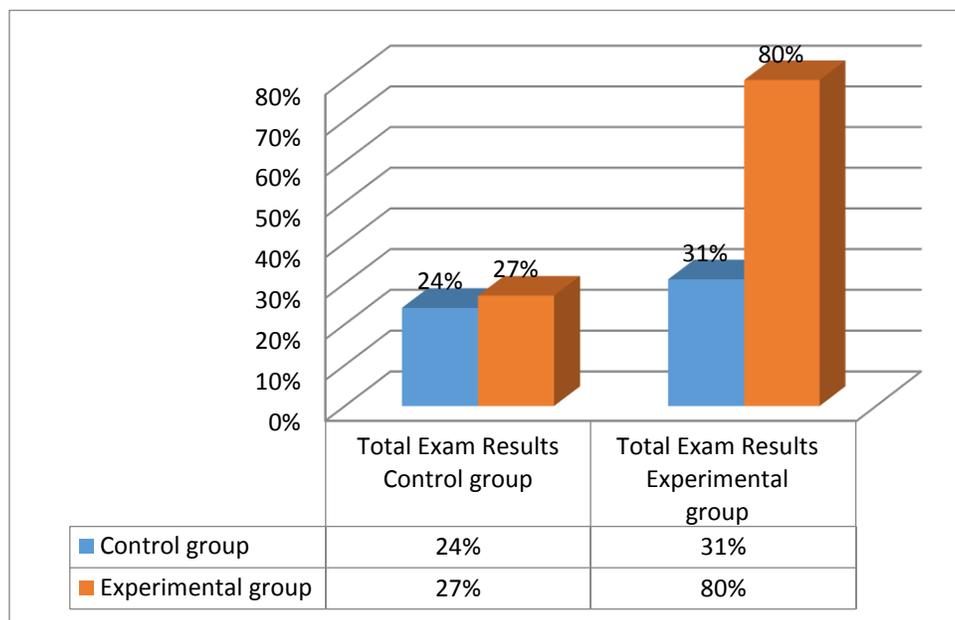


Figure 3. Total average scores for both groups

Figure 4 clearly displays the success of the systematic method. To see the differences between the two diagrams, the distribution of the scores has been compared to the normal score distribution. The interrupted line represents the distribution of the exam points before method application, whereas the unbroken line represents distribution of the exam points after the application of the SALT. The interrupted line represents the distribution of the exam points of the control group whereas the unbroken line represents distribution of the exam points of the experimental group in exam.

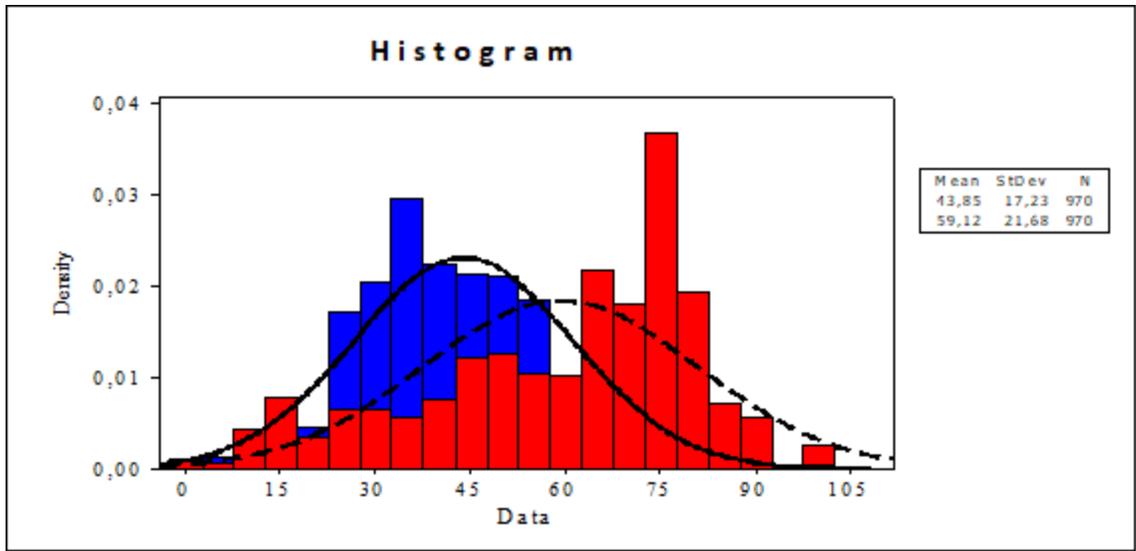


Figure 4. Distribution of the scores of students of the control group and the experimental group

Figure 5 displays the correlation of the points accumulated by the experimental group before and after the application of the SALT. As can be noticed, there is a very good correlation. The correlation coefficient is 0.92. Besides, the graphs show that the students of the control group encounter difficulties in the exam with regard to the systematic questions.

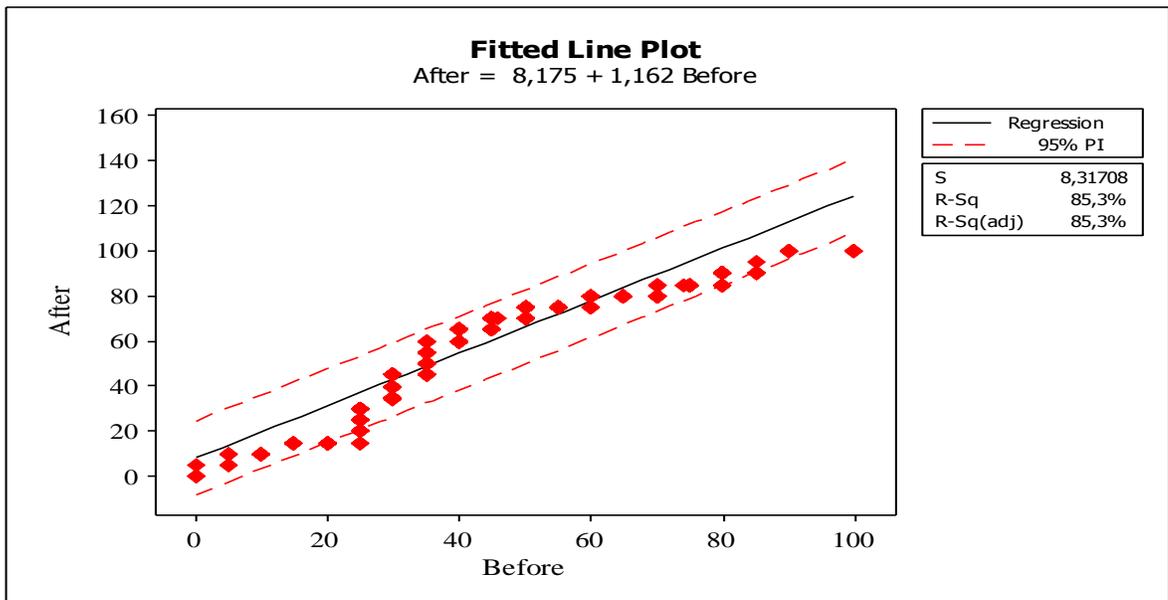


Figure 5. Correlation of the points accumulated by the experimental group

## **SUMMARY**

Based on the result of the study which lasted for ten years, I jumped into the conclusion that the application of the systematic method in teaching and learning biochemistry is successful [12-33]. The application of the Systemic Approach to Teaching (SAT) is a tool designed to help teachers teach and students learn.

During the application of this method, the lecturer:

- is more globally than ethnically oriented,
- shows a special interest to the culture and its perspective,
- is oriented towards the future,
- has profound trust in the human potential,
- considers the student as a process which continuous all the life,
- takes care about the development of the individual in general,
- employs the systematic approach to organize learning/teaching units, establishes new relationships between teachers, between teachers and students, and among students,
- employs the systematic teaching unit which carries a range of innovations and demonstrates the possibilities of overcoming the traditional model which is still currently practiced in our schools,
- employs the systematic relationship of teaching and learning methodologies which allow for the development of thinking skills and different types of the processes of thinking, such as creative thinking, critical thinking and problematic thinking.

The application of this method:

- i. promotes students to participate in the organization of the tutorial (teaching unit).
- ii. allows revising and expanding students' knowledge obtained in the previous lessons.
- iii. allows students to create rich environment for both quality and quantity information.
- iv. helps students develop their skills and provides them with a collection of knowledge through learning by giving up knowledge provision through available sources.
- v. prompts students to have a research role in the learning process and enables to express their own ideas and thoughts,
- vi. offers new sources of information, motivates students to acquire new information, rely on prior knowledge and deepen it through the various stages of systematic learning.
- vii. allows for knowledge construction and not knowledge transmission,
- viii. motivates students to learn as well as to identify and correct prior inaccurate understanding.

This analysis shows that the present technological society needs:

- people who do not routinely do what previous generations did, but people who are capable of doing new things
- creators, inventors, discoverers, capable of not accepting ready-made facts, but capable of critically verifying them
- people motivated to learning.

This could be made possible only through the systemic approach in learning and teaching chemistry (SALT). In my opinion, this process should begin at child's early age through arousing the academic qualities of the child's mind. In this way, we increase child's' responsibility to learn by reflecting a current dimension of learning.

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