# SYSTEMIC OBJECTIVE TEST IN MEDICAL BIOCHEMISTRY PART 1- METABOLISM OF CARBOHYDRATES

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## ABSTRACT

A very important element of the teaching plan is students' assessment. Assessment should be very objective and backed up with feedback. A necessary condition for this type of evaluation is the formation of questions. The questions should lead the thinking process of the students with skills and clarity of thought. In this way, these questions will serve as clear ideas and help to develop the imagination and the research. Such innovation provides systematic evaluation, which is based on systematic diagram. Testing plays an important role in this system. The objective test is created in a way that a different estimator that 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 this article, we will introduce STFQs, SMCQs, SSQs, SSQs, ASQs, and SCQs as examples of the systemic objective test in medical biochemistry. *[AJCE, 4(1), January 2013]*

## INTRODUCTION

Asking questions lies on the basic foundation of communication, especially the lecturer-student communication. It a process that lecturers and students come across every day. Asking questions is a practice that does not only serve to know who knows the answer is, it also supports the student to make him/her more competent to find the right answer through different ways (1). In most cases, asking questions helps the lecturer to check students' knowledge and verify if they did their work.

According to Blum's taxonomy, the abilities of thinking are classified in six levels, in a hierarchic way from the lowest level to the highest one. Blum's taxonomy was revised adapting the questions according to the levels of thinking. It is very important to understand that every type of question introduces a way of thinking, listed in a hierarchic way as well. Nowadays, questioning is not as it used to be in the traditional teaching, where only the teacher used to ask; now it's a mutual process between the teacher and the student. Systemic objective test can challenge students and test higher learning levels (analysis, synthesis, and evaluation (2).

Analytic questions are questions of the high level, they require critical thinking. Analytic questions usually require two different kinds of thinking; to separate the knowledge in components and to see the connections between two or more components. The synthesis questions constitute another kind of questions of the high level. These questions expect from the student to put in order the ideas that they learned previously and combine these ideas in a way to create new models or new products. The evaluation questions stand on top of the taxonomy. These questions expect the student to do two important things. The first thing that they have to do is to create criteria to support their judgment and the second is that they have to judge by using these criteria.

## METHODOLOGY

The study was carried out at the University of Shkoder "Luigj Gurakuqi" (Albania) in the Faculty of Natural Sciences, at the Department of Biochemistry, with the students of the first study degree, in the subject of biochemistry. Initially, the students were shown the application of the SATL as the module "*Part 1- Metabolism of Carbohydrates"* was being taught. Students were divided into groups at will. The first group acts as an experimental group whereas the second operates as controller. The research involved 65 students in the control group, which was taught using the linear approach; 115 students formed the experimental group, which was taught using SATL methods illustrated in the systemic diagrams. The lecturer provides both groups with the necessary explanations. The module was taught for a semester. Two exams were organized, one before method application, the other after its application for equivalence.

The examination for both groups used to measure the achievement over the subject matter incorporated in both the system and the linear type questions. The final data in terms of students' achievement are shown Figures 1 and 2. The exams incorporated systematic and linear questions for both groups. The best assessment is 100 points; the minimum passing assessment is 35 points.

The success of the systemic approach to teaching biochemistry was established by using an experimental group, which was systemically, and control group, which was taught in the classical linear manner. Following the teaching exercise through SATL technique, it is quite natural to assess the students through the same medium. This not only helps to determine the scale of comprehension the learner acquires via SATL lesson, but also examines such aspects of students' knowledge that they learn through classical teaching methods.

Systemic learning based test, presently known as systemic objective test (SOT), could be an instrument for determining the scale of learning level as: analysis, synthesis and evaluation. Systemic objective tests are developed and the following few examples explain this aspect of a SATL teaching lesson.

To make up systemic questions, the geometric forms of the questions should be determined. Shapes are the building units of the systemic questions (3-4)). Geometric shapes are different such as triangular, quadrilateral, pentagonal, hexagonal, etc, depending on the number of concepts that are incorporated in the diagram. Construction of systemic questions requires the realization of some requirements such as:

- Determination of the types of relations between the given concepts.
- Determination of the size of the building of systemic diagrams.
- The items in the left (column A) are usually called premises. The items in the right (column B) are called responses.
- Provide the information in the stem and keep the options as clear systemics.
- Put in the stem the information and make the problem clear and specific.

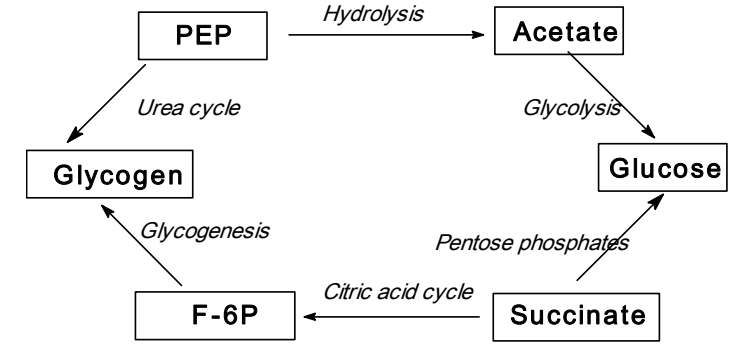
The following examples are intended to illustrate how systemic question have been used in biological chemistry (5).

**Type I:** Systemic True / False Questions (STFQs).

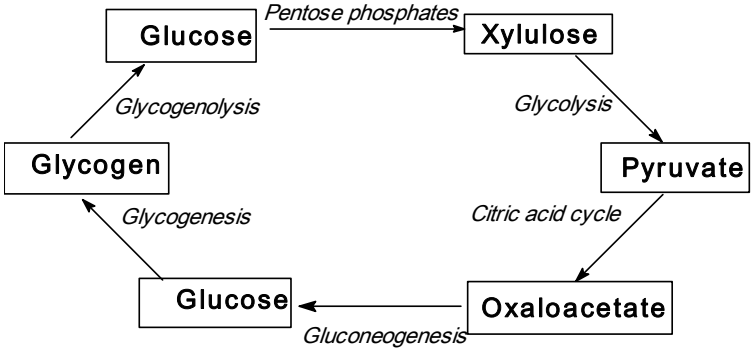
Systemic True/False Questions are well suited for testing students' comprehension, synthesis, and analysis. STFQs require a student to assess whether a statement is true or not, however, they require a student to assess whether a systemic diagram is true or false.

**Example**

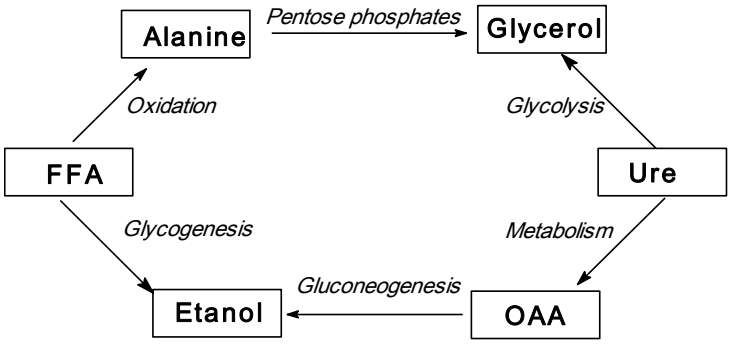
**Q-1.** The systemic diagram represents the correct relations between major pathways. Indicate which of the following systemic diagrams are true (T) and which are false (F):



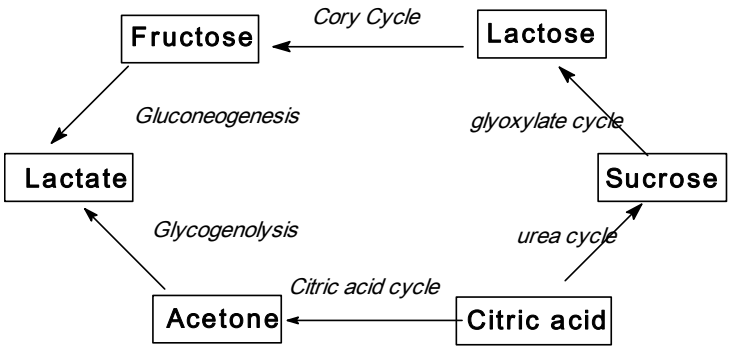

a. (----- )




b. (----- )




c. (----- )




d. (----- )

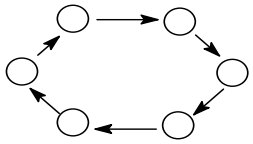
**Answer:** True systemic diagram is (a): False systemic diagrams are (b, c & d)

**Type II:** Systemic Matching Questions (SMCQs).

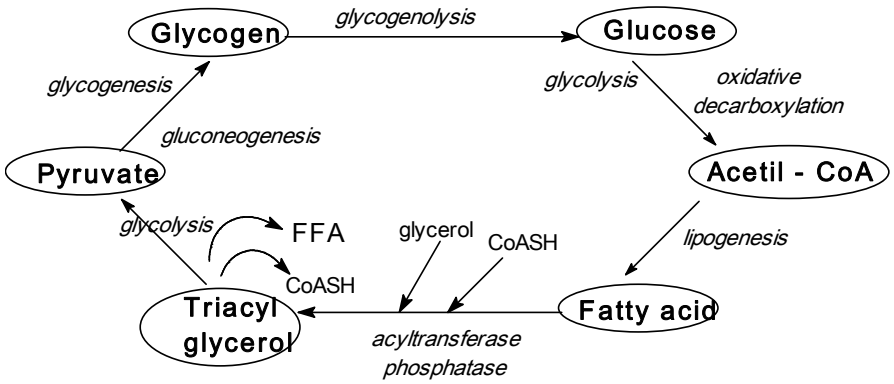
Systemic Matching Questions measure the student's ability to find the relationship between a set of similar items each of which has two components, their relationships, and arrange them in a given systemic diagram. The student has to choose from the concepts and given relations and create a systemic diagram.

**Example**

**Q-1.**Choose compounds from column (A) and metabolic processes from column (C) to build the correct systemic relations in column (B):

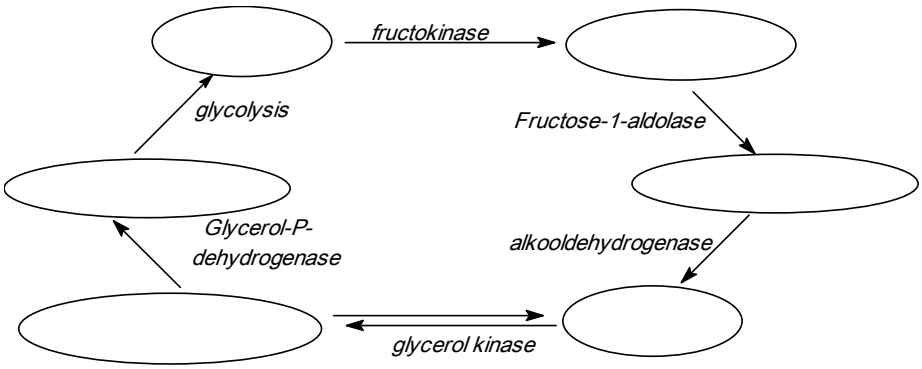
| Collumn (A ) | Collumn (B ) | Collumn (C ) |
|---|---|---|
| Glycogen<br>Pyruvate<br>Glucose<br>Fatty acid<br>Acetil - CoA<br>Triacylglycerol |  | *glycogenesis*<br>*oxidative decarboxylation*<br>*lipogenesis*<br>*glycolysis*<br>*glycogenolysis*<br>*gluconeogenesis*<br>*acyltransferase*<br>*phosphatase*<br>glycerol<br>FFA<br>CoASH |

**Answer:**

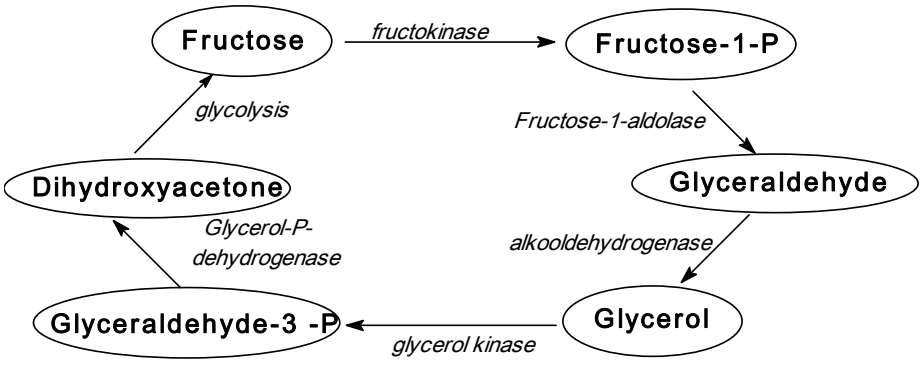



**Type III.** Systemic Sequence (SSQs) measure students' skills to determine the concept and the relationships according to the given sequence in the systemic diagram.

**Q-1.** Put the following compound in the correct sequence in the following systemic diagram that shows metabolism of fructose**.**

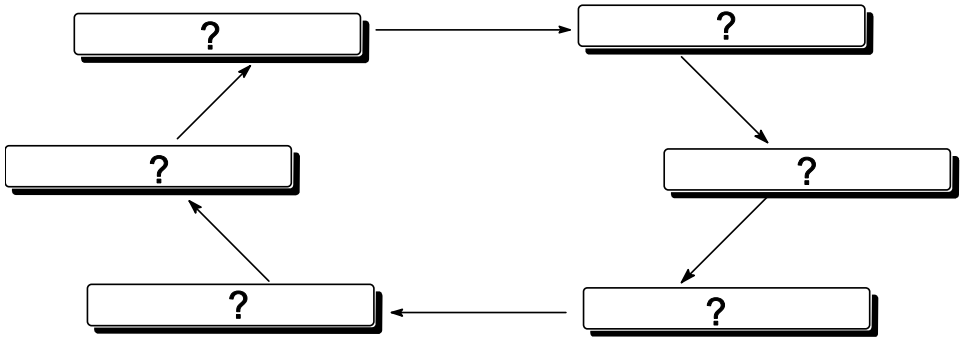



**Answer:**

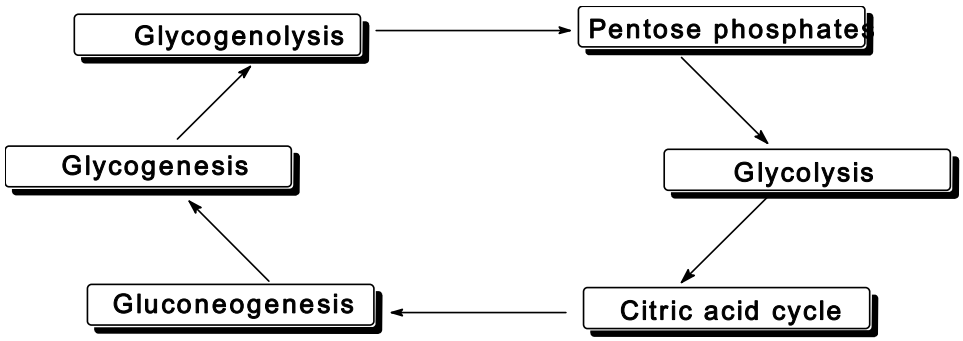


**Type IV**. Synthesize Systemic Questions (SSQs) measure various kinds of knowledge, including students' ability to correlate between concepts, formula, or events. The student determines the relation between the concepts in the systemic diagram.

**Q-1.** Build a correct systemic diagram to show the relations between major pathways: glycogenolysis, pentose phosphate, glycolysis, citric acid cycle, gluconeogenesis, glycogenesis.

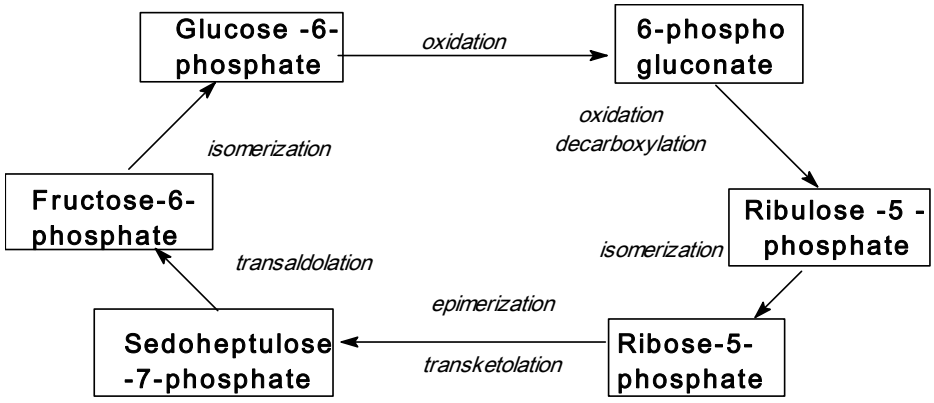



**Answer:**




**Type V.** Analyze Systemic Questions (ASQs) assess higher-order thinking skills in which students are able to analyze**.** The student analyzes the concepts and their relations in the given diagram.

**Q-1.** Analyze the catabolic other fate of the glucose.




**Answer:**

$C_6H_{11}O_6P + NADP+ + H_2O \xrightarrow[\text{lactonase}]{\text{glucose-6-P-dehydrogenase}} C_6H_{10}O_8 + NADPH$

$C_6H_{10}O_8 + NADP+ \xrightarrow[\text{somerization}]{\text{oxidation/decarboxylation}} C_5H_9O_5P + CO_2 + NADPH$

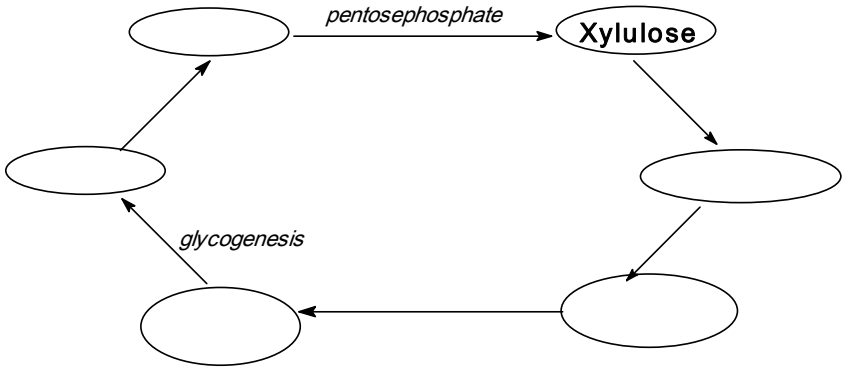
$C_5H_9O_5P + C_5H_9O_5P \xrightarrow[\text{transaldolase}]{\text{transketolase}} C_7H_{11}O_6 + C_3H_5O_3P$

$C_7H_{11}O_6 + C_3H_5O_3P \xrightarrow{\text{transaldolase}} C_6H_{12}O_5P$

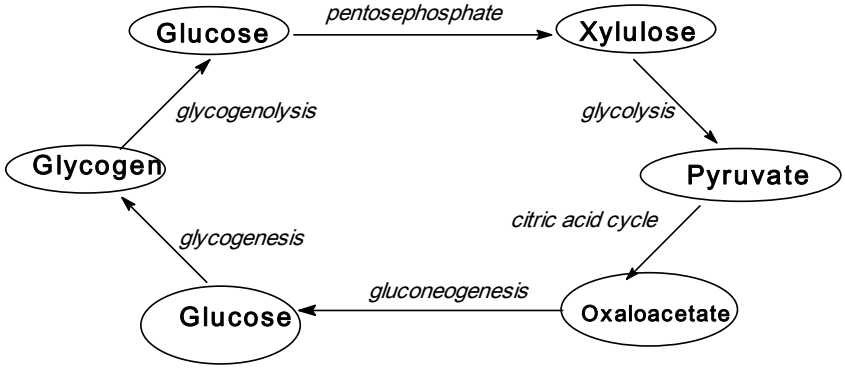
$C_6H_{12}O_5P \xrightarrow{\text{isomerase}} C_6H_{12}O_5P$

**Type VI.** Complete Systemic Questions (CSQs) assess higher-order thinking skills in which students are able to analyze. The student fills out the concepts or formulas, numbers or events that are missing in the given diagram.

**Q-1.**Complete the following systemic diagram to show glucose metabolism



**Answer**




## RESULTS

Graphs have been drawn to display the percentage of the students' average scores on examination components indicated (linear questions or systemic question). On the left hand bar of each couple of graphs, the points before the exam have been displayed, whereas on the right hand bar the points of the exam after the application of the methods have been displayed.

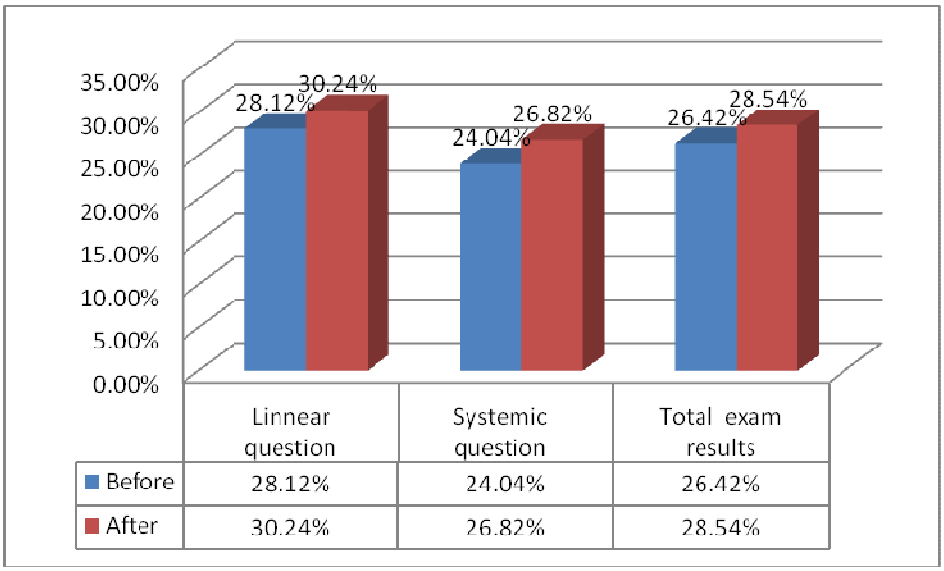



*Figure 1.* Average scores of the control group before and after the application of the SATL

Figure 1 above shows the average scores of the control group before and after the application of the SATL. The control group had an average score of 28.12% on linear question and an average score of 24.04% on systemic questions before application while had an average

score of 30.24% on linear question and an average score of 26.82 % on systemic questions after application.

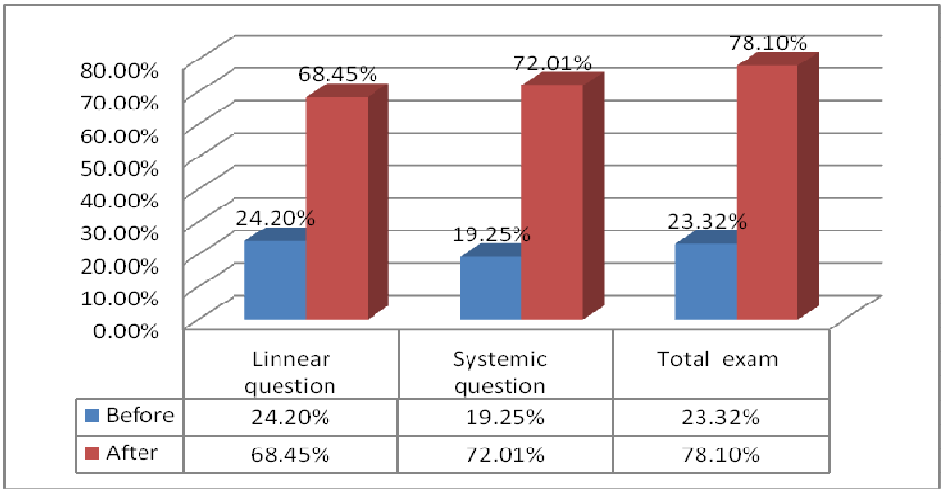



*Figure 2*. Average scores of the experimental group before and after the application of the SATL.

Figure 2 shows the average scores of the experimental group before and after the application of the SATL. The experimental group had an average score of 24.20% on linear question and an average score of 19.25 % on systemic questions before application while had an average score of 68.45 % on linear question and an average score of 72.01 % on systemic questions after application.

These data indicate a marked difference between the control group and experimental group. As can be noticed from the graphs, students of the control group encounter difficulties in the exam with regard to the systematic questions thus the control group had an average score of 19.25 % contrasted to 24.04%,. The experimental group achieved at a higher level as measured by the total average score on the examination (78.10 versus 28.54%).

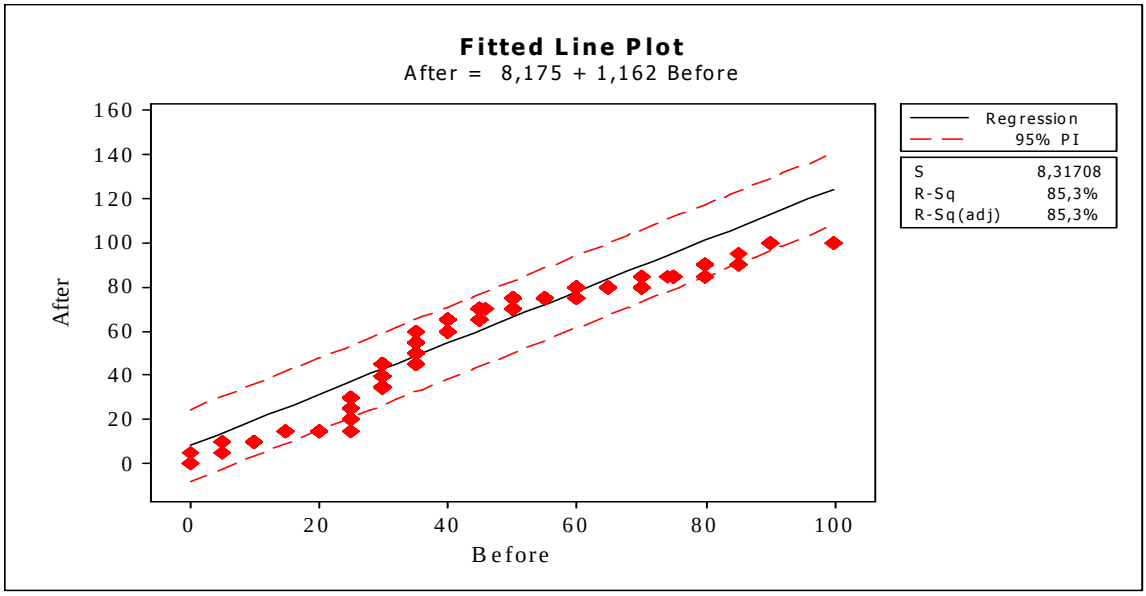



*Figure 3* . Correlation of the points accumulated by the experimental group

Figure 3 above 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.

## CONCLUSIONS

Making up systemic questions in medical chemistry positions the students differently in the auditorium. The benefits of this new positioning are:

- Students develop their skills and abilities to recognize problems and to 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 could increase their creativity.

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