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Cooperative and collaborative learning as a strategy to facilitate learning.

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Summary

Six groups of students enrolled in the Organic Chemistry III Teaching-Learning Unit (LTU), were divided in two sets, in order to evaluated their learn style and knowledge construction. In the first set of three groups, the transmission of knowledge was conventional in traditional blackboard lectures given by the teacher in which the students were receivers and took notes, while in the second set of groups, a cooperative and collaborative group learning strategy was applied so that the students worked together to solve common problems designed by the professor. This research was carried out over an academic year, involving a total of 150 students. The results obtained in the evaluation showed a failure rate of 65% for those groups in which conventional teaching techniques were used in contrast to 17% for the students who worked together in solidarity. The student response presented here is discussed in function with techniques involving the socialization of knowledge, learning amongst peers and collaborative learning, new forms of constructivist socialized knowledge and the contrary effects of the traditional teacher-centered method.

Key words. Learning styles, Strategy, Collaborative learning.

Introduction

In the majority of the universities and centers of higher education in Mexico Organic Chemistry courses tend to be problem courses with high failure rates because students do not have the conceptual information and language necessary to answer the questions in the diagnostic examinations. This is due to the way in which the subject is presented by the professor as a theoretical class inadequately contextualized within the curriculum, thus creating conditions in which the classroom dynamic is virtually divided into two elements: one, active dependent and exclusive to the professor and the other, receptive and passive on the part of the students who receive the discourse. The disadvantages of this procedure have been pointed out by educational researchers: it deactivates reflection and the capacity to use the knowledge acquired as a potential resource and encourages the conditions for a purely individual formation. One alternative to solve the problems associated with the construction of knowledge in organic chemistry courses is the application of new strategies such as fomenting team work, with constructivist actions in collaborative teams and the reorientation of the class towards solving day-to-day problems which encourage the application of information in the understanding of the problems provided and which generate theories in the form of analogies that explain a given piece of knowledge.

The aim of our research was to study the influence of collaborative learning in three-member groups, oriented towards problem solving in the subject of organic chemistry in higher education through the implementation of group work and collaborative learning.

Student population

The two teaching-learning methods were used in the Universidad Autónoma Metropolitana-Iztapalapa with students from the east side of Mexico City and its metropolitan area in the undergraduate degree program in Industrial Biochemical Engineering and Food Engineering who were enrolled in the 03-Winter, 04-Spring and 04-Autumn trimesters, courses corresponding to the University's conventional three trimester academic year. Most of the students from both programs were enrolled in the fifth trimester, which did not mean that they were regular students, i.e. students who did not have subjects pending from earlier trimesters. It should be pointed out that the students enrolled in the autumn trimester were pupils who were taking this Teaching-Learning Unit for the

second time. The students' ages ranged from 20-24 years, and the groups were mixed (men and women).

Installations

The buildings in which the classes were given corresponded to those available for teaching in the Iztapalapa campus, identified with the letters B, C, and D and oriented north-south. The classrooms used could hold up to 63 students, were furnished with tubular seats which were fixed to the floor and set out in rows of nine chairs. They were grouped into two sections of 3 and 4 rows separated by a central aisle. Each room had a side large window providing a view to the exterior which served as a source of natural light as well as neon tube strip lighting fixed to the ceiling for artificial illumination. There was also a 6 x 1.2 m. blackboard, a desk and seats fixed to the floor for the use of the professor.

Course implementation

Methodology

Two methodologies were applied: one a traditional teaching method in which the professor decided on the topics to be taught, the methodology, class presentation and the way to evaluate students while the second involved what is known as group learning in solidarity in which students and teacher decide on a problem to solve as well the assigning of individual and groups tasks. Similarly, the answering of individual exams and the discussion of what had been achieved was carried out according to criteria established by the teacher or the group. The work done by each individual was handed in by the team for its respective evaluation.

Traditional system

The traditional class format was applied to the groups BE08-B, BD08-B BE08-B with student populations of 43, 32 y 37 respectively and a totalof 112 students. The duration of each class was five hours per week distributed in two 1 ½ hour sessions and one 2 hour session similar to that established for the groups assigned to the cooperative team learning experience. The following two classes were used to carry out a diagnosis of students' knowledge of Organic Chemistry I (the TLU prerequisite for enrollment in Organic Chemistry II) which involved an analysis of the following concepts: Lewis structures, formal and partial charges, resonance, electronegativity and acid-base reactions. The results obtained showed a scarce handling of the knowledge required of the topics

dealt with in the diagnostic test. As a result of this analysis, the following two sessions were used by the professor to quickly revise the topics in organic Chemistry I. A short 30 min. period was used to review the topics and then exercises were done individually. Once the revision had been done, the course was continued in a traditional manner, the teacher gave a presentation of the topics and the students merely took notes and answered questions at the end of the class. These groups were graded with mid-term and final exams as well as a grade obtained in the laboratory.

Learning in cooperative groups

Working in cooperative groups as a strategy for collaborative learning was applied to groups BE08C, BE08A and BE08A with populations of 45, 29 y 37 respectively involving a total of 111 students.The duration of each class was five hours per week distributed in two 1 ½ hour sessions and one 2 hour session. On the first day of the course students were given copies of the TLU program, the aims that it was hoped to achieve were explained as well as the elements to evaluate the learning and participation of the students and the required bibliography. The same diagnostic test as that used in the traditional system was applied in the three groups and later the meaning of learning in solidarity was explained by the professor from his/her own point of view. Students were also given a copy of the article by Johnson D. and Jonson (1994), followers of the Behaviorism theoryschool, with the aim of familiarizing them with the achievements and skills that it was hoped that they would have acquired by the end of the course by following the procedure of collaborative team learning. During these sessions the students formed three-member teams. The professor taught part of the following two classes with different topics and provided exercises for students to do in class. The same period was used by the professor to detect those students with a better handling of information when applying concepts required in the course, and later it was proposed that these individuals should be assigned the role of team facilitators during the whole trimester. Once the facilitators had been identified, in the following classes the learning teams were formed on the basis of affective social affinity however, the aim was to ensure that a student facilitator should remain in each group throughout the trimester.

Throughout the trimester the professor used an average 30 minutes of class time to propose and clarify the objectives to be achieved during each session, focusing on the concept. The rest of the

session was used by the students to solve problems in teams following the proceduremention edabove**.** The teacher facilitator (professor) only intervened at the request of the student teams and in the case of doubts being expressed or to broaden the referents. Once the problems had been solved (in teams), an environment encouraging debate, analysis and the integration of concepts was encouraged to benefit team learning. In all groups there were three evaluations the sum of which made up for 70% of the final grade, and the other 30% being obtained in the laboratory class coordinated by another professor.

Laboratory work

The practical work in the traditional system involved applying chemical procedures determined by the professor and carried outindividually like kitchen recipes by the students. In the case of the collaborative system, the practical laboratory sessions followed a pattern similar to that used in classroom work, that is to say, in collaborative teams and accompanied by a different teacher who had also been trained in the methods used in this type of collaborative work.

Data analysis

Numerical coding was used in order to be able compare our results with the system of letters used by the University for evaluation purposes. Thus, “MB” was the equivalent of the interval between 8.8 and 10 points, “B” for 7.5 to 8.7, “S” for 6 to 7.4 and NA for less than 6. In the case of the statistical analysis, an average was calculated for the grades in order to obtain a single value of 10, 8, 6 and 5 in the same order as the equivalencies mentioned above. The grade also took into account a value obtained for attendance, participation in group work and carrying out practical work in the laboratory. The data reported in the final evaluation were averaged according to the trimester, the education system used and the difference between means was evaluation using a correlation test. (PASW 2009)

Results

The comparison of the pass grades for each system is presented in Table 1 which shows that in the Traditional system the students had fewer MB (very good) marks than those in the Cooperative

system. When this latter teaching-learning technique was applied, there were more students who obtained the grades MB or B (good) compared to those with S (sufficient)

Table 1. Distribution of pass grades in the groups of students in both the traditional and cooperative systems.

	Traditional system			
Trimester	Total no. of students	% MB	% B	% S
Winter	43	5	25	19
Spring	32	9	18	12
Autumn	37	13	22	19
	Cooperative learning system			
Trimester	Total no. of students	% MB	% B	% S
Winter	45	31	33	18
Spring	29	24	52	6
Autumn	37	49	22	3

It should be noted that the highest failure rate was found amongst the students studying in the traditional system as can be seen in Table 1.

Table 2. Fail grades in the groups of students in both the traditional and cooperative systems

	Cooperative learning system	
Trimester	Total no. of students	%
Winter	45	18
Spring	29	17
Autumn	37	16
	Traditional system	
Trimester	Total no. of students	%
Winter	43	51
Spring	32	59
Autumn	37	46

Discussion

In the conditions under which the present study was carried out, aspects for discussion were related to cooperative and collaborative learning method in contrast with those students who were taught the course in the traditional manner. In this study it became clear that the intervention of a student facilitator reduced the failure rate on the course and thus improved the handling of the knowledge acquired that had been proposed by the teacher facilitator. This situation can be explained if we take into account that in the educational process different factors related to learning such as disposition, communication, handling of concepts, confidence, affection and gratification intervene amongst students who share similarities: age, tastes as well as verbal and non-verbal language.

A number of authors have shown that the orientation towards learning groups or teams should be interpreted has an awareness of self-management and the consolidation of the appropriation of knowledge for learning; that is to say, it is the student who should be interested and need or require themselves to learn topics set out during the course. In the case of there being no such motivation, in the traditional system of teaching, no professor or facilitator will be of use to the student. The need or motivation was evident when it was observed that the highest grades reported were found in the autumn trimester which corresponded to the students who were taking the course for the second time and who, as well as having been familiar with the language were required to pass the course although no there was no trimester effect in the results of the study. In the case of the Traditional method, the teacher is faced with the consequences of their own vertical and authoritarian scheme of transmission of knowledge which impedes the students reaching the states of attention-relation-apprehension (Javier Olvera, 2003, personal communication). In both systems, what stands out is the fact learning in itself is symbolically represented as an obstacle to be overcome in the mind of the student, while for the facilitator it is difficult to achieve the substitution of short-term memorization and mechanization in order for there to be effective learning by the student.

In the integration of the work teams, it became obvious that the groups of students showed shared language, reasoning, perception and moments of attention which favored the construction and meaning of knowledge amongst them: This was a consequence (in the constructivist conception of learning) that the knowledge acquired is organized within the learning environment, the attitudes

towards dialogue as partial aims held in common by the team and the explicit logic with respect to the procedures and instruments to be applied in order to achieve these aims which allows students to understand and build the fundamental idea that the student is the one responsible for their own learning process. The formation of teams was directed to ensure that each one included a student facilitator and this model permitted permanent feedback between the student facilitators and the rest of the team which directly reduced failure rates.

Some researchers have mentioned that difficulty of learning applied to the field of science education describes a situation in which a student presents problems with appropriating knowledge in classes in which there is a unidirectional flow of information on the part of the professor and in some cases, in the solving of a given problem. According to different authors Carretero, M. (1997), the difficulties are explained as a result of prejudices about the teaching-learning unit and that the characteristics of the students store of knowledge and cultural baggage on which their capacity to interrelate depends, in particular the meaningful appropriation of information in order to establish meaningful connections between elements of learning and the concepts that they are required to learn. In this sense, it should be remembered that learning is made up of a formative aspect and an informative one, the former focusing on the analysis, logic and criteria of the discipline and the latter on what is in the bibliography, the complexity of the task and the lack of ingenuity to establish analogies that explain and lastly, on the capacity of the student to organize and process new information. Suárez, (1995), for example, considers that learning difficulties can have internal origins derived from the student's capacity to organize and process information or difficulties external to the individual related to the nature of what is to be learned itself.

A collateral aspect reported in the present study that merits future research is the cause of persisting failure rates despite the introduction of team cooperative systemlearningwork. According to various authors Kempa, R. (1991) failure as a phenomenon associated with not learning occurs due to the fact that it is impossible to establish socio-affective, constructive relations or positive conditions inherent to the student and their particular situation rather than factors associated with the facilitator. It is well-known in the field of pedagogy that traditional teaching systems promote passivity on the part of the student and are built around students' presupposed deficiencies, that is,

in the case of Organic Chemistry, the professors taught their classes according to a set of topics that they themselves had established by him/herself on the assumption that they would transmit and thus satisfy the curricular knowledge required without the participation of the students who are considered “ignorant and incompetent to do so”. This model could be the cause of the high failure rates reported for this system, in contrast to the other system in which the student intervenes in the construction of their own knowledge. This type of traditional system is in fact the creator of the threatening subjects on university curricula amongst which we find the different Chemistry courses that have high failure rates and the consequent frustration and expulsion of students from the education systems

In conclusion, we could say that cooperative and collaborative learning is an alternative technique that should be implemented extensively in the teaching of those subjects that require the learning of a new attitude, procedure and language by higher education students, as in our case, Organic Chemistry. An aspect that should be focused on is the detection of student leaders without the intervention of the professor facilitator which would reduce external participation in the formation of learning groups and reaffirm self-management as a new instrument in which the task of the professor facilitator is opened up to include the subject of the educational process, the student him/herself.

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