

## **Innovative TaDDEI Workshops to Develop Independent Study Skills in Students Enrolled in Chemistry Courses**

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<sup>3</sup>TaDDEI Faculty participants of the Department of Chemistry, Humacao University College of the University of Puerto Rico include Carmen S. Delgado, José A. Díaz Piñero, Carmen López de Fuentes, José Malavé López, Samuel Rodríguez Ponce, Gabriel Barletta, Margarita Ortíz, Mirna Rivera, and Juan Suárez.

Yolanda Vaillant Sanz is a Professor in the Department of Chemistry at Humacao University College of the University of Puerto Rico. She developed and pioneered the TaDDEI workshops to enhance student learning in the Chemistry courses. The TaDDEI concept has been extended to other courses (such as Biology) and other universities.

David Santiago is an Assistant Professor and the chairperson of the Department of Chemistry at Humacao University College of the University of Puerto Rico. He has supported the TaDDEI workshops over many years and helped to institutionalize the offering of these workshops to Chemistry students.

Michael Rubin is an Associate Professor in the Department of Biology at Cayey University College of the University of Puerto Rico where he teaches genetics and undergraduate research into the molecular mechanisms underlying synapse formation. Dr. Rubin organized the information and wrote this manuscript about the TaDDEI workshops.

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### **Abstract**

TaDDEI (Development of study / learning skills within the context of a course) Workshops within the context of the chemistry courses were designed to develop independent study skills needed for successful course outcomes. These workshops were based upon the “Learning to Learn” Program offered by the University of Syracuse, Constructivist learning theories and algorithms, and behavior modification. Approximately 30% of the students enrolled in general and organic chemistry courses at the Humacao Campus of the University of Puerto Rico (UPR) participated in these workshops over the past six years. Preliminary results indicate a substantial increase in study frequency and satisfactory course outcomes (final grades of A, B, or C) by workshop participants compared with non-participants, independent of cumulative grade point average (GPA). A synergism emerged involving TaDDEI Workshop assessment, academic planning and development, curriculum revision, program and course assessment, accreditation, formative and summative teaching evaluations, and external funding endeavors for education and research.

### **Introduction**

Since 1993, increasing numbers of University of Puerto Rico (UPR) Natural Sciences students enrolled at the Humacao Campus have participated in a series of workshops designed to develop independent study skills needed for success in chemistry courses. These workshops, tightly coordinated and integrated with the chemistry classes, were designed to help participants develop essential skills necessary for improved comprehension of chemistry course content. This interaction allows the professors to appreciate fully the difficulties that their students face in understanding and learning the course material. In addition, such an approach facilitates a constructivist emphasis to the

dynamics of teaching and learning. Collaborative study between small groups of students fosters an effective communication between students and with their professors. Strategies of collaborative study between small groups of students enhanced effective communication. These workshops provide opportunities, outside the traditional classroom setting, to learn new study techniques that facilitate critical reading, conceptualization, problem solving, decision making, and an increased understanding of course content.

The “Learning to Learn” Program offered by the University of Syracuse provided some aspects of the model that was adapted for use at the University of Puerto Rico. The University of Syracuse Program was a

general one designed to help students in a number of different courses. The University of Puerto Rico Program was tailored specifically to our university situation and to chemistry courses by identifying the minimum concepts and skills needed (“Less is More”). The TaDDEI workshops familiarize the student participants with the cognitive skills that are the foundation for the recommended study techniques. The processes of knowledge acquisition and concept formation includes comprehension (integration of new knowledge with previously acquired knowledge) that involves classification and organization of stored knowledge in memory to facilitate localization and use in the analysis of various situations.

In TaDDEI workshops, an algorithm is taught and practiced consisting of the sequence of mental operations that should be systematically executed when applying the recommended study techniques. The problem solving algorithm consists of reading the problem, distilling the data, understanding what is required, classifying the type of problem, imagining physically (by drawing), classifying formulas and data visually by creating an information map, preparing flowcharts to arrive at the solution using different ways of structuring the problem, and finally making decisions. An analogy to a computer model is useful: saving information in short term memory and relating new knowledge to existing knowledge prior to classification and organization in a flexible way to facilitate information retrieval. During group activities and individual study, participants systematically apply the corresponding algorithm. The systematic repetition of the corresponding algorithm facilitates the creation of new approaches of analysis and the comparison of different elements of the study material. Once the student is comfortable with the study techniques, the student can modify the algorithm adapted it to their preferred learning style mode. A

specific learning model with a general procedure for analysis involves several elements: critical reading, conceptualization, problem solving, and decision making.

The goals of the TaDDEI Workshops are to strengthen cognitive processes, improve study skills, and increase frequency of study for the participants. This goal should impact general problems by increasing retention of natural sciences students, decreasing course failures and repetitions by students resulting in a decrease in the average time needed for graduation. An additional benefit exposes and familiarizes professors of introductory courses to new methodologies of teaching and learning. Finally, the TaDDEI project conducts periodic assessments about student study habits and provides the resulting information to course and departmental coordinators. These assessment results pinpoint the main academic difficulties of the participating students. Such information facilitates decision making to improve educational services.

## Methods

### Course and Workshop Setup and Functioning:

Students enrolled in specific chemistry courses served by the TaDDEI project are offered the opportunity to participate in the workshops and supporting experiences. Various personnel participate in the TaDDEI project including student mentors, professors, and a coordinator. Student mentors are selected who successfully completed the course and received “A” or “B” as a final grade. These mentors work closely with approximately ten participants in support groups during one-hour weekly meetings. Professors offer the workshops to the student participants using cooperative learning experiences. A coordinator is responsible for assuring that the activities are uniform and consistent between the

different working groups, and for the production of materials and assessment of the outcomes.

The organization of the TaDDEI project consists of three activities. The central activity is the TaDDEI workshops offered by a professor with the assistance of a student mentor. These are offered to approximately twenty-five participants for one and a half hours weekly. Small student work groups, with a maximum of four participants, collaborate on problem solving, table preparation, conceptual maps, graphs, summaries, and important questions to aid in organizing the study material for discussion. The professor and student mentors act as facilitators to the student work groups. The students identify questions regarding the essential concepts. At this point the professor, using a question and answer approach systematically following the procedure of the corresponding algorithm, reconstructs the progress of the various groups and clarifies misconceptions and answers questions. In the final phase of the workshop, the professor provides an assignment that forces the students to critically read the corresponding chapter, apply the pertinent techniques, and solve problems. The students include this work in a portfolio that becomes a study tool. The professor and the student mentors revise the portfolio two times a semester. The second activity of the TaDDEI Project is the support groups. Student mentors meet with a small group of approximately ten participants for one hour each week. This forum provides an opportunity for students to identify and address problem areas and to discuss concepts needing clarification. The student mentors evaluate the correct application of the discussed techniques. The third activity of the TaDDEI Project is the weekly staff meeting. The coordinator meets with the professors and student mentors to determine and evaluate course progress during the previous week, to plan course content for the following week, and to discuss and solve

any problems encountered in the various components. The coordination meeting also provides a forum for introducing new pedagogical techniques, both in theory and in practice.

#### Illustrative Workshop Module Contents:

The workshop modules discussed include some of the following:

*Personal Goals: Academic and Professional* - Development of academic and professional goals. This module involves introspection to determine career goals and provides direction and motivation for the academic program and future study.

*Time Management* - Plan the use of time and self-discipline to carry out the plan. This module involves weekly time planning and daily reflection to compare accomplishments with planned activities.

*Class Note Taking* - Effective note taking as a complement to the textbook and as an opportunity to address difficult concepts and clarify misunderstandings. This module provides skills to take notes that are complete, organized, and clear. The module also emphasizes the use of notes to complement other resources for effective study.

*How to Generate Questions during Study* - The importance of questions and the inquiry approach to problem solving, understand conceptual frameworks, and identify chemical mechanisms. This module addresses clear and simple question posing, keen observation of potential answers, and objective analysis of data and answers.

*Conceptualization and Concept Maps* - Graphic and visual ways to organize material to facilitate understanding and memorization. This module emphasizes skills to create maps that emphasize relationships between concepts studied. Many maps are possible for a given area.

Effective maps illustrate specific relationships between short clear phrases that clarify the overall structural framework of the subject matter.

*Comparative Tables* - Construction of tables to organize, summarize, and compare information. This module provides skills to use tables to organize information to compare and contrast various characteristics and features of the topic of interest. Comparative tables reveal similarities and differences between concepts, theories, information, and procedures by visual presentation.

*Solving Numerical Problems* - Effective strategies for solving number problems. This module presents procedures and algorithms to analyze problems requiring numerical solutions.

*Reading for Comprehension* - Techniques for improving understanding from reading material. This module emphasizes reading techniques to increase comprehension and retention of the study material.

*Simplified Study Method* - Effective study method for increased understanding and retention. This module presents a simple and effective study method that consists of pre classroom preparation of material and post classroom review. Preparation before classroom discussion serves to identify concepts not understood. This can help to identify and eliminate conceptual errors. Review after the classroom experience increases understanding and retention.

#### “Student Handbook” and “Professor and Mentor Handbook”

Handbooks are available for the participant as well as for the professor and student mentor. The Spanish language handbook compiles all of the information necessary for a successful experience. The “Student

Handbook” contains general information concerning the TaDDEI project, the content and a description of the work to be carried out, the general learning algorithm which comprises the conceptual framework of the experiences, the study modules describing the techniques used in the workshops, and other related information (Vaillant Sanz, 1999). The “Professor and Mentor Handbook” contains the material included in the “Student Handbook” as well as theoretical and practical teaching information.

#### Collection of Data:

The effectiveness of the TaDDEI project was assessed using information obtained from various sources. An important source of information for this study was the report (STD-440-B) compiled by the Office of the Registrar of Humacao University College containing the registered students for each semester organized by academic program and student number. This report contains academic information for each student including university entrance parameters, accumulated grade point average, and number of credits completed. Other information used included official class lists of all course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups.

A questionnaire was developed for students enrolled in chemistry courses, to ascertain student perception of their study habits, the difficulties they have encountered, and the TaDDEI project. This questionnaire consists of several sections requesting information regarding general student data and study habits. Additional questions are included regarding student perception about difficulties encountered, usefulness of study materials, and their opinion about the TaDDEI project experiences.

### Statistical Analysis of Data:

Statistical analysis of the data was carried out to identify statistically significant differences between the data sets.

## **Results**

### Student Participation in TaDDEI Workshops Increases Percentage Satisfactory or Better Achievement in Chemistry Courses

The assessment of the TaDDEI project using official class lists of all course sections with the final grade for each student as well as lists of student attendance for the workshops and support groups demonstrated positive results. In general, positive course outcomes (satisfactory or better final grades) are achieved by TaDDEI participants and extend to all chemistry courses served by the project. From 1993 through 1998, a significant increase is observed in the percentage of satisfactory or better grades in the General Chemistry I and Organic Chemistry I courses obtained by TaDDEI participants whereas no significant difference is observed in satisfactory or better grades obtained by the non-participants (Figures 1a and 1b). This improvement in the final grades of TaDDEI participants was not dependent on the student's cumulative grade point average (GPA) in the General Chemistry I and II courses and the Organic Chemistry I course. For all students regardless of GPA, a significant increase is observed in the percentage of satisfactory or better grades in the General Chemistry I and II courses obtained by participants when compared to the non-participants (Figures 2a and 2b). For all students regardless of GPA, a significant increase is observed in the percentage of satisfactory or better grades in the Organic Chemistry I course obtained by participants when compared to the non-participants (Figure 3a). The improvement in the final grades of TaDDEI participants

was found to be dependent on the student's cumulative grade point average (GPA) in the Organic Chemistry II course. For students with GPAs greater than 2.5, a significant increase is observed in the percentage of satisfactory or better grades in the Organic Chemistry II course obtained by participants when compared to the non-participants. (Figure 3b).

### Student Participation in TaDDEI Workshops Increases Study Frequency

Student responses to a perception study carried out during the first semester of the 1997- 1998 academic year was used to ascertain changes in study habits impacted by the project. In general, TaDDEI participants improved their study habits through an increase regularly scheduled study and a decrease in cramming for exams. A significant increase in the percentage of General Chemistry I and Organic Chemistry I students who studied several times weekly and a concomitant decrease in the percentage of students who only studied before exams is observed in the TaDDEI participants when compared to the non-participants (Figure 4a and 4b). A significant increase in the percentage of General Chemistry I and Organic Chemistry I students with a GPA of 3.0 or greater who studied several times weekly and a concomitant decrease in the percentage of students who only studied before exams is observed in the TaDDEI participants when compared to the non-participants (Figure 5a and 5b). General Chemistry students with GPAs greater than 2.0 improved their study habits through an increase regularly scheduled study and a decrease in cramming for exams. An increase in the percentage of General Chemistry I and Organic Chemistry I students with a GPA between 2.5 and 2.99 who studied several times weekly and a concomitant decrease in the percentage of students who only studied before exams is observed in the TaDDEI participants when compared to the non-participants (Figure 6a

and 6b). An increase in the percentage of General Chemistry I students with a GPA between 2.0 and 2.49 who studied several times weekly and a concomitant decrease in the percentage of students who only studied before exams is observed in the TaDDEI participants when compared to the non-participants (Figure 7a). All non-participants in TaDDEI with a GPA between 2.0 and 2.49 only studied before exams (Figure 7b).

## Discussion

The assessment of the TaDDEI project over the past six years has consistently demonstrated positive results. A substantial improvement in the percentage of satisfactory grades (A, B, and C) by TaDDEI participants was observed. An increase in the study frequency by TaDDEI participants compared with non-participants was also observed. The increase in the percentage of satisfactory grades (A, B, and C) as well as the increase in the study frequency by TaDDEI participants was independent of their cumulative grade point average (GPA). The best students (with GPA of 3.0 or greater) show a significant increase in their final grades and study habits through participation in TaDDEI experiences.

Assessment consisted of identification of information sources, data acquisition, data analysis, formulation of recommendations, and dissemination of information for decision making. TaDDEI assessment has provided quantitative data to the course coordinators and the Chemistry Department that has resulted in improved understanding of student abilities and needs. This resulted in the establishment of new admissions parameters for the Chemistry Department academic programs. The academic profile

of the student participants of the TaDDEI project and some academic difficulties faced by all students in General Chemistry, Organic Chemistry, and some sections of Physical Chemistry were determined.

A synergism emerged between TaDDEI Workshop assessment, academic planning and development, program and course assessment, curriculum revision, accreditation, formative and summative teaching evaluations, and external funding endeavors for education and research. This synergism contributes to improvement in the quality of science education for our students.

## Acknowledgements

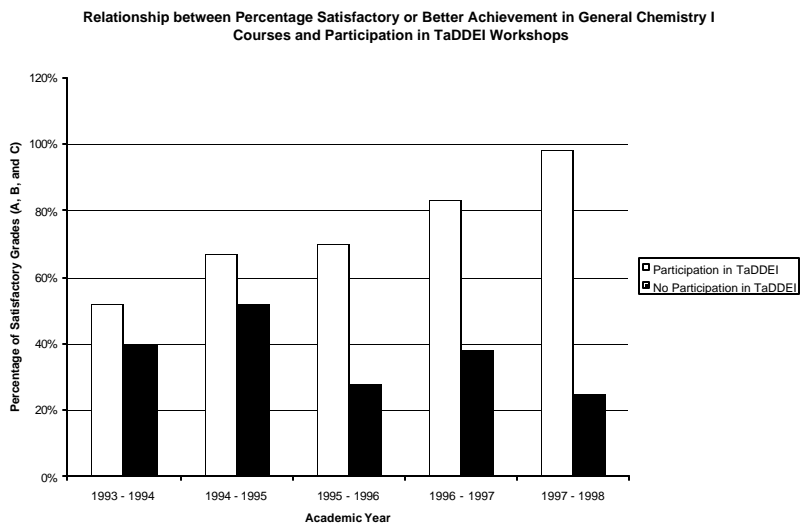
We thank the National Science Foundation for supporting the Alliance for Minority Participation of the Puerto Rico Resource Center for Science and Engineering for making possible this work in part. The CUH Naval Research Program, the IDEAS Project (Title III), the Office of the Chancellor, the Office of the Dean of Academic Affairs, and the Chemistry Department at Humacao University College of the University of Puerto Rico provided additional support for this project. We also thank the student participants and mentors of the TaDDEI project.

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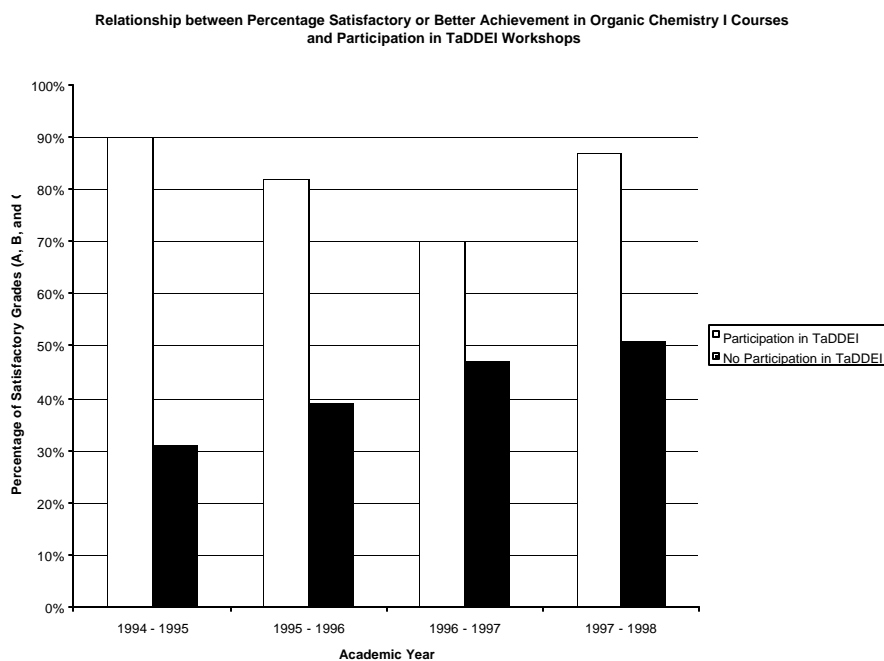
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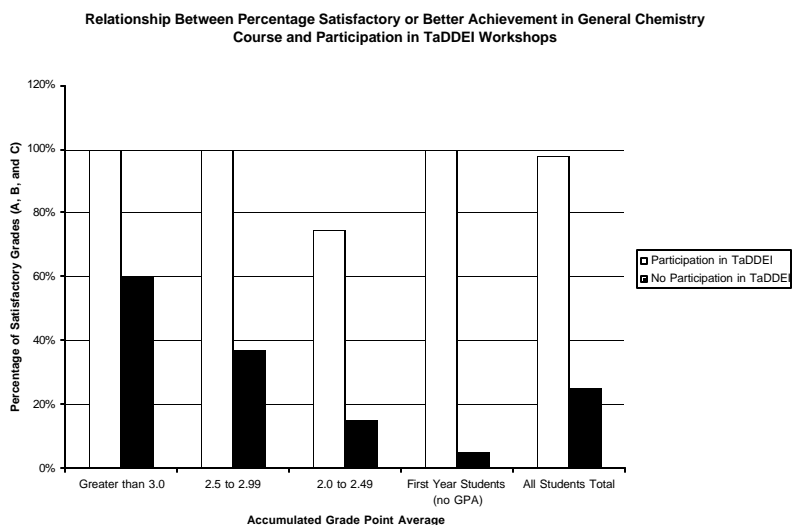
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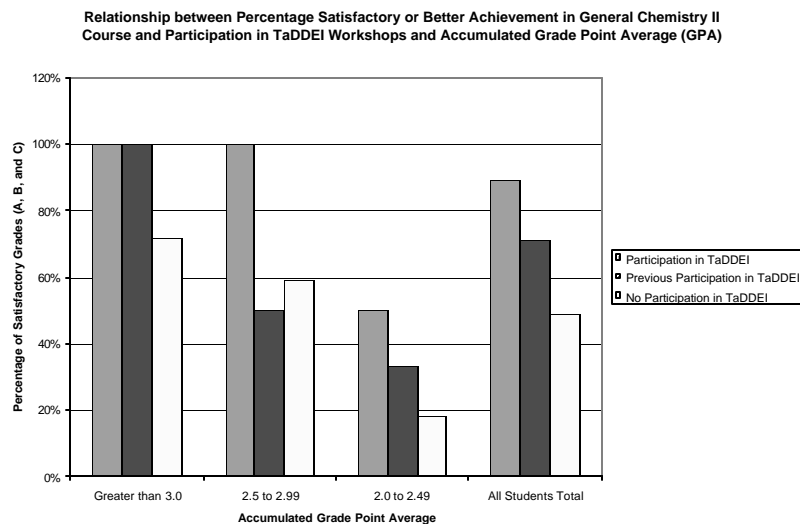
**Figure 1a: Relationship between Percentage Satisfactory or Better Achievement in General Chemistry I Courses and Participation in TaDDEI Workshops.** For each academic year from 1993 to 1998, the percentage of satisfactory or better grades (A, B, and C) in the General Chemistry I course obtained by TaDDEI participants were compared with the percentage of satisfactory or better grades obtained by non-participants. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all General Chemistry course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. From 1993 through 1998, a significant increase is observed in the percentage of satisfactory or better grades in the General Chemistry I course obtained by participants whereas no significant difference is observed in satisfactory or better grades obtained by the non-participants.



**Figure 1b: Relationship between Percentage Satisfactory or Better Achievement in Organic Chemistry I Courses and Participation in TaDDEI Workshops.** For each academic year from 1994 to 1998, the percentage of satisfactory or better grades (A, B, and C) in the Organic Chemistry I course obtained by TaDDEI participants were compared with the percentage of satisfactory or better grades obtained by non-participants. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all Organic Chemistry course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. From 1994 through 1998, a significant increase is observed in the percentage of satisfactory or better grades in the Organic Chemistry I course obtained by participants whereas no significant difference is observed in satisfactory or better grades obtained by the non-participants.



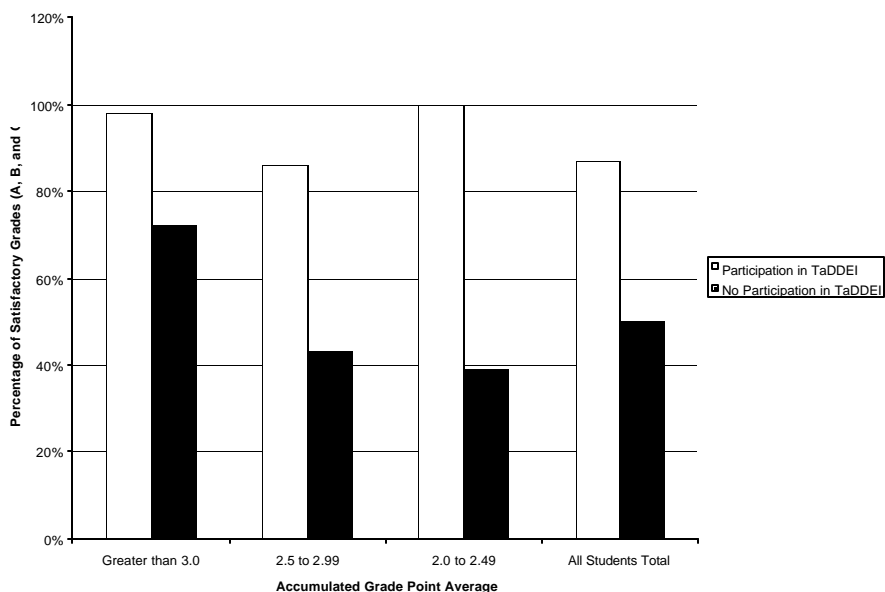
**Figure 2a: Relationship between Percentage Satisfactory or Better Achievement in General Chemistry I Course and Participation in TaDDEI Workshops and Accumulated Grade Point Average (GPA).** For four different groups of students with varying accumulated grade point averages (GPAs), the percentage of satisfactory or better grades (A, B, and C) in the General Chemistry I course obtained by TaDDEI participants were compared with the percentage of satisfactory or better grades obtained by non-participants. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all General Chemistry I course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. For all students regardless of GPA, a significant increase is observed in the percentage of satisfactory or better grades in the General Chemistry I course obtained by participants when compared to the non-participants.



**Figure 2b: Relationship between Percentage Satisfactory or Better Achievement in General Chemistry II Course and Participation in TaDDEI Workshops and Accumulated Grade Point Average (GPA).** For four different groups of students with varying accumulated grade point averages (GPAs), the percentage of satisfactory or better grades (A, B, and C) in the General Chemistry II course obtained by TaDDEI participants were compared with the percentage of satisfactory or better grades obtained by non-participants. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all General Chemistry II course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. For students with GPAs greater than 2.5, a significant increase is observed in the percentage of satisfactory or better grades in the General Chemistry II course obtained by participants when compared to the non-participants. For students with a GPA greater than 3.0, previous experience in TaDDEI had a lasting effect on the percentage of satisfactory or better grades in the General Chemistry II course.

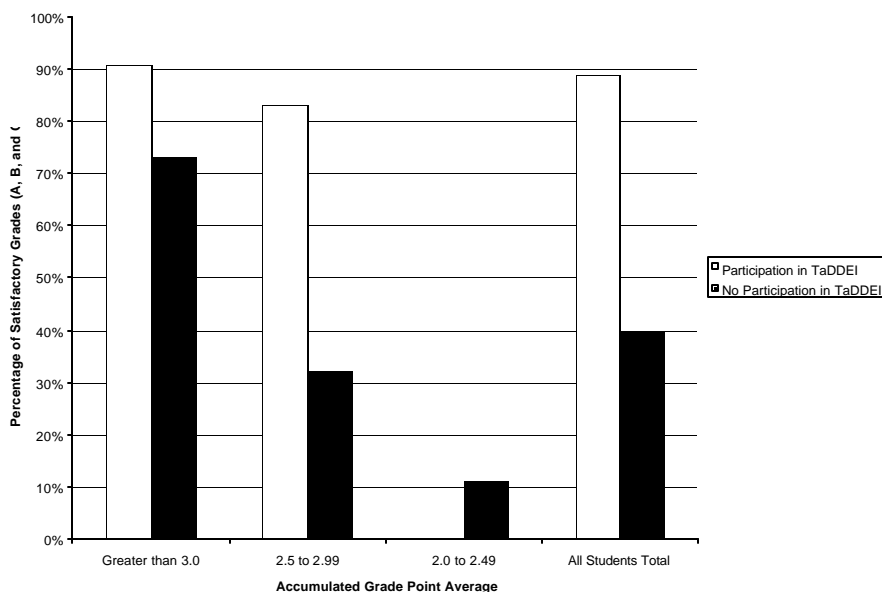
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Relationship between Percentage Satisfactory or Better Achievement in Organic Chemistry I Course and Participation in TaDDEI Workshops and Accumulated Grade Point Average (GPA)



**Figure 3a: Relationship between Percentage Satisfactory or Better Achievement in Organic Chemistry I Course and Participation in TaDDEI Workshops and Accumulated Grade Point Average (GPA).** For four different groups of students with varying accumulated grade point averages (GPAs), the percentage of satisfactory or better grades (A, B, and C) in the Organic Chemistry I course obtained by TaDDEI participants were compared with the percentage of satisfactory or better grades obtained by non-participants. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all Organic Chemistry I course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. For all students regardless of GPA, a significant increase is observed in the percentage of satisfactory or better grades in the Organic Chemistry I course obtained by participants when compared to the non-participants.

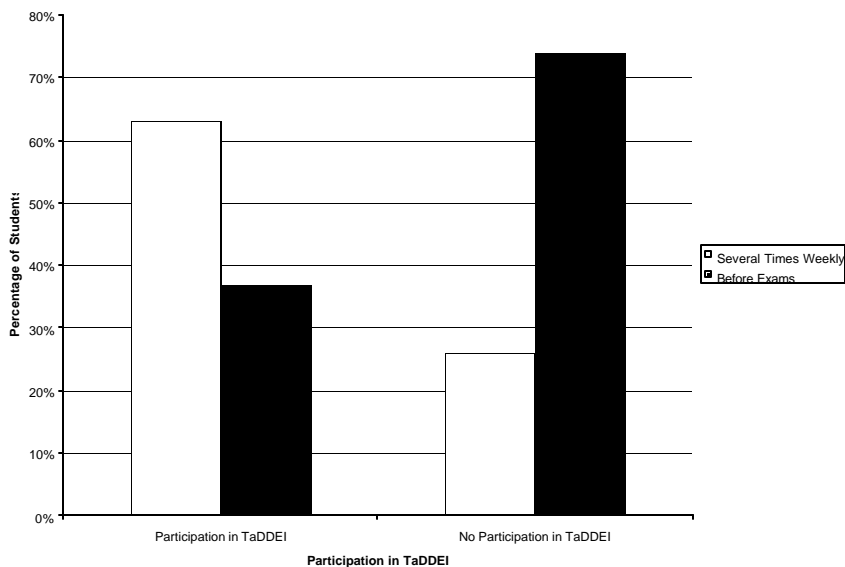
Relationship between Percentage Satisfactory or Better Achievement in Organic Chemistry II Course and Participation in TaDDEI Workshops and Accumulated Grade Point Average (GPA)



**Figure 3b: Relationship between Percentage Satisfactory or Better Achievement in Organic Chemistry II Course and Participation in TaDDEI Workshops and Accumulated Grade Point Average (GPA).** For four different groups of students with varying accumulated grade point averages (GPAs), the percentage of satisfactory or better grades (A, B, and C) in the Organic Chemistry II course obtained by TaDDEI participants were compared with the percentage of satisfactory or better grades obtained by non-participants. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all Organic Chemistry II course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. For students with GPAs greater than 2.5, a significant increase is observed in the percentage of satisfactory or better grades in the Organic Chemistry II course obtained by participants when compared to the non-participants.

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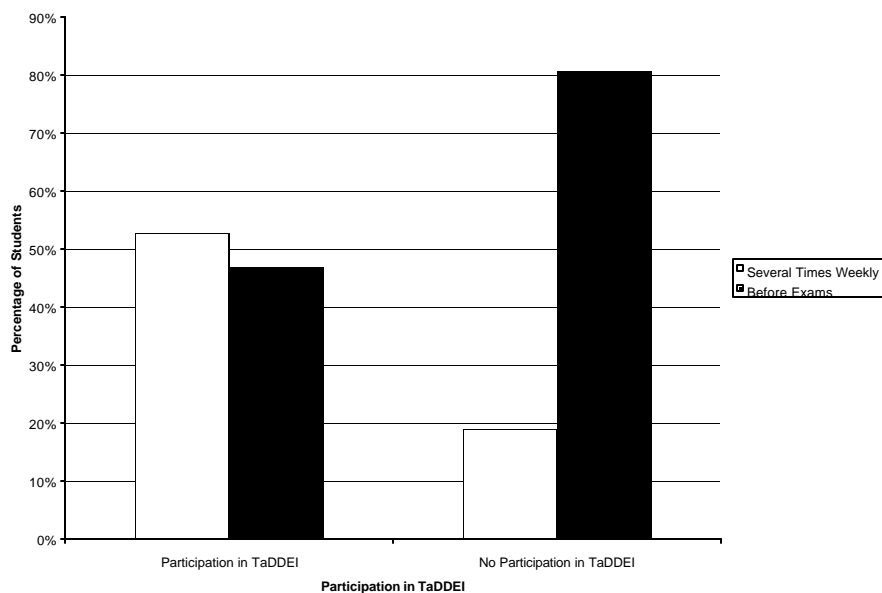
Relationship between Study Frequency and Participation in TaDDEI Workshops - Student Responses to Perception Study (First Semester 1997- 1998) General Chemistry I



**Figure 4a: Relationship between Study Frequency and Participation in TaDDEI Workshops - Student Responses to Perception Study (First Semester 1997- 1998) General Chemistry I.** Between participant and non-participants of TaDDEI, the percentage of General Chemistry I students who studied several times weekly was compared with the percentage of students who only studied before exams. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all General Chemistry I course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. A significant increase in the percentage of General Chemistry I students who studied several times weekly and a concomitant decrease in the percentage of students who only studied before exams is observed in the TaDDEI participants when compared to the non-participants.

**Figure 4b: Relationship between Study Frequency and Participation in TaDDEI Workshops - Student Responses to Perception Study**

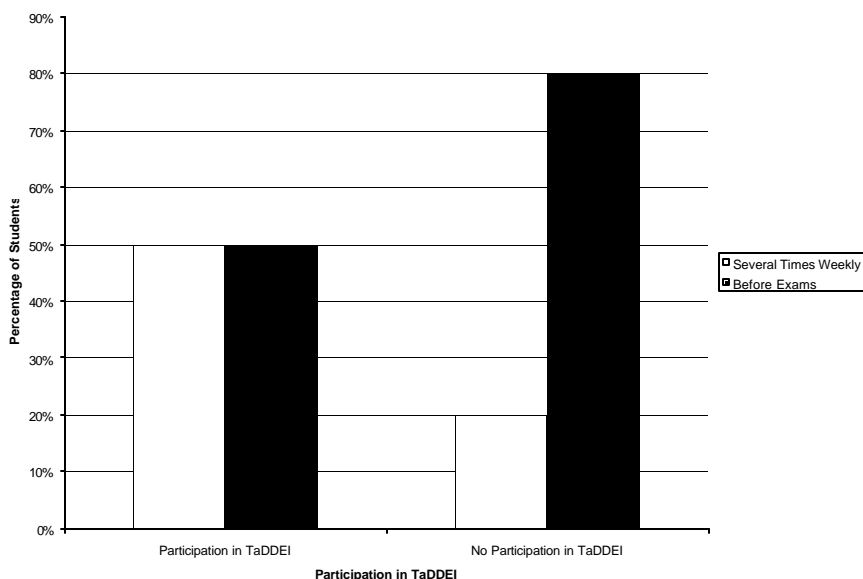
Relationship between Study Frequency and Participation in TaDDEI Workshops - Student Responses to Perception Study (First Semester 1997- 1998) Organic Chemistry I



**(First Semester 1997- 1998) Organic Chemistry I.** Between participant and non-participants of TaDDEI, the percentage of Organic Chemistry I students who studied several times weekly was compared with the percentage of students who only studied before exams. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all Organic Chemistry I course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. A significant increase in the percentage of Organic Chemistry I students who studied several times weekly and a concomitant decrease in the percentage of students who only studied before exams is observed in the TaDDEI participants when compared to the non-participants.

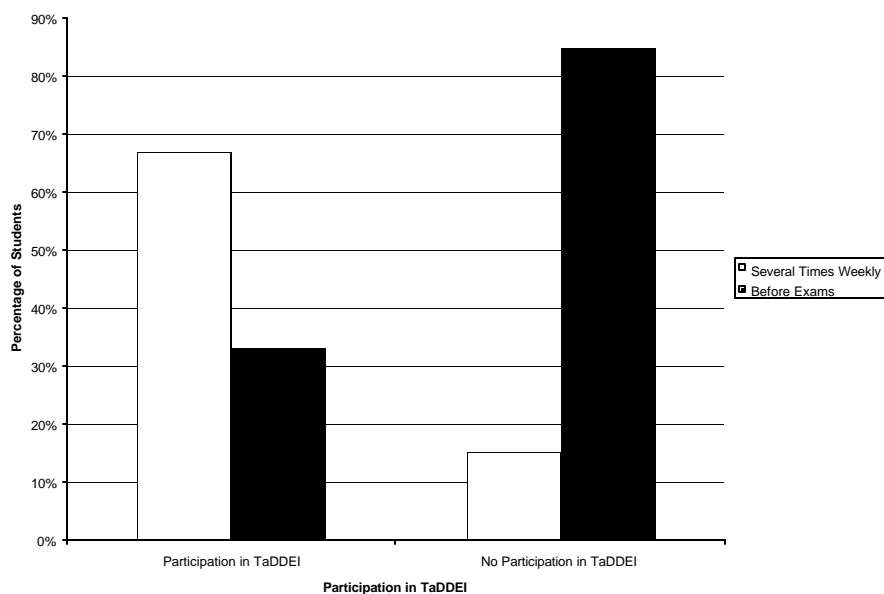
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Relationship between Study Frequency and Participation in TaDDEI Workshops - Student (With GPA 3.0 or Greater) Perception (First Semester 1997- 1998) General Chemistry I



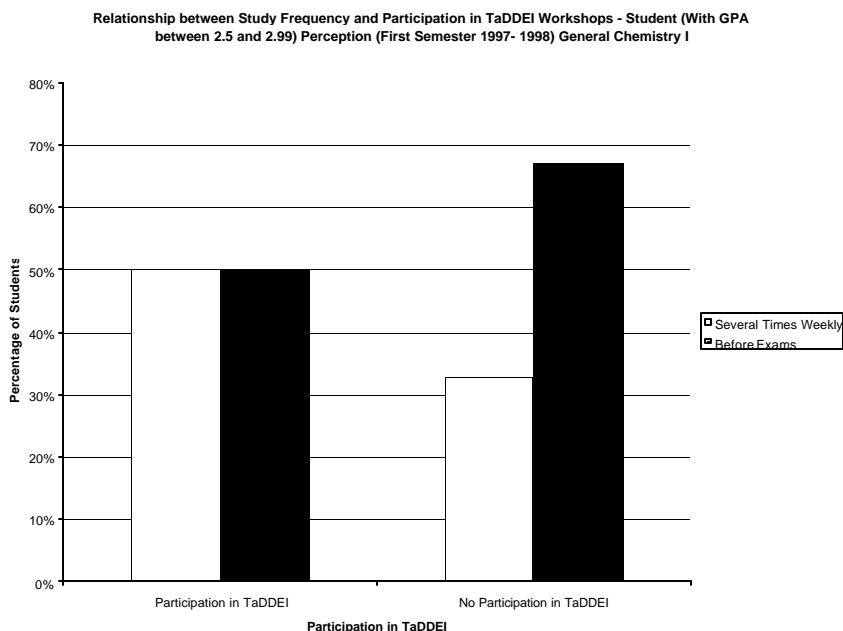
**Figure 5a: Relationship between Study Frequency and Participation in TaDDEI Workshops - Student (With GPA 3.0 or Greater) Perception (First Semester 1997- 1998) General Chemistry I.** Between participant and non-participants of TaDDEI (With GPA 3.0 or Greater), the percentage of General Chemistry I students who studied several times weekly was compared with the percentage of students who only studied before exams. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all General Chemistry I course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. A significant increase in the percentage of General Chemistry I students with a GPA of 3.0 or greater who studied several times weekly and a concomitant decrease in the percentage of students who only studied before exams is observed in the TaDDEI participants when compared to the non-participants.

Relationship between Study Frequency and Participation in TaDDEI Workshops - Student (With GPA 3.0 or Greater) Perception (First Semester 1997- 1998) Organic Chemistry I

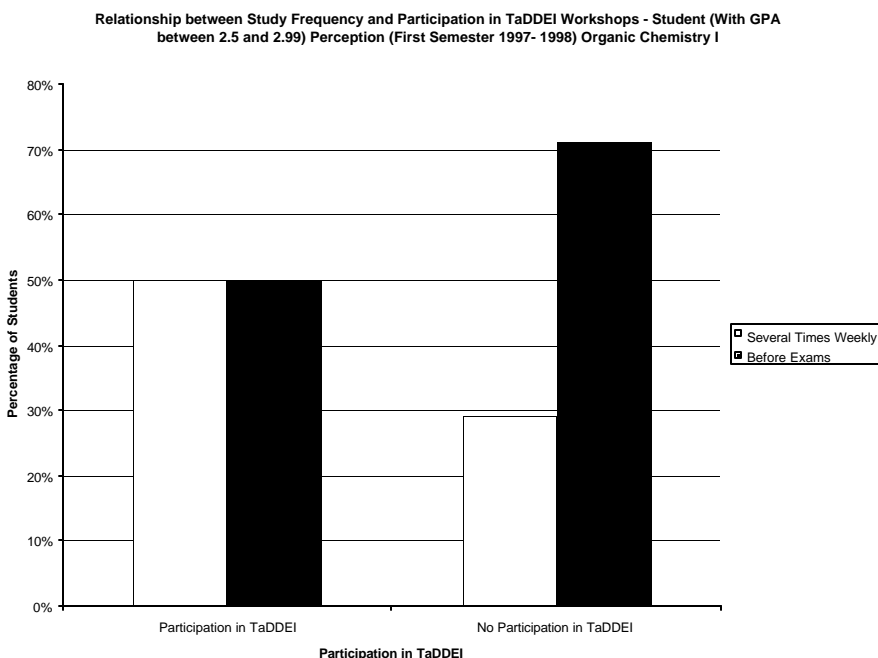


**Figure 5b: Relationship between Study Frequency and Participation in TaDDEI Workshops - Student (With GPA 3.0 or Greater) Perception (First Semester 1997- 1998) Organic Chemistry I** Between participant and non-participants of TaDDEI (With GPA 3.0 or Greater), the percentage of Organic Chemistry I students who studied several times weekly was compared with the percentage of students who only studied before exams. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all Organic Chemistry I course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. A significant increase in the percentage of Organic Chemistry I students with a GPA of 3.0 or greater who studied several times weekly and a concomitant decrease in the percentage of students who only studied before exams is observed in the TaDDEI participants when compared to the non-participants.

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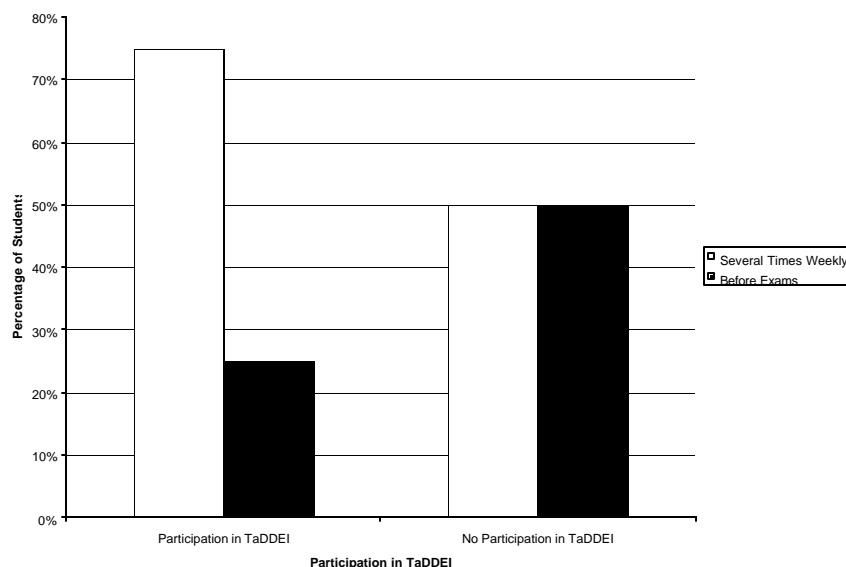
**Figure 6a: Relationship between Study Frequency and Participation in TaDDEI Workshops - Student (With GPA between 2.5 and 2.99) Perception (First Semester 1997 - 1998) General Chemistry I.** Between participant and non-participants of TaDDEI (With GPA between 2.5 and 2.99), the percentage of General Chemistry I students who studied several times weekly was compared with the percentage of students who only studied before exams. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all General Chemistry I course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. An increase in the percentage of General Chemistry I students with a GPA between 2.5 and 2.99 who studied several times weekly and a concomitant decrease in the percentage of students who only studied before exams is observed in the TaDDEI participants when compared to the non-participants.



**Figure 6b: Relationship between Study Frequency and Participation in TaDDEI Workshops - Student (With GPA between 2.5 and 2.99) Perception (First Semester 1997 - 1998) Organic Chemistry I.** Between participant and non-participants of TaDDEI (With GPA between 2.5 and 2.99), the percentage of Organic Chemistry I students who studied several times weekly was compared with the percentage of students who only studied before exams. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all Organic Chemistry I course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. An increase in the percentage of Organic Chemistry I students with a GPA between 2.5 and 2.99 who studied several times weekly and a concomitant decrease in the percentage of students who only studied before exams is observed in the TaDDEI participants when compared to the non-participants.

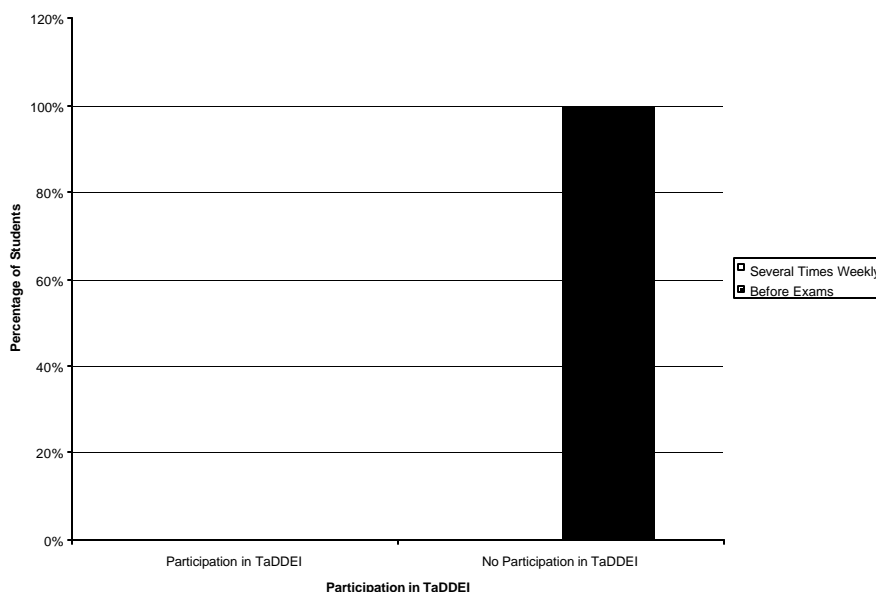
Innovative Workshops to Develop Independent Study Skills  
 David Santiago, Michael Rubin, Yolanda Vaillant Sanz, and TaDDEI Faculty

Relationship between Study Frequency and Participation in TaDDEI Workshops - Student (With GPA between 2.0 and 2.49) Perception (First Semester 1997- 1998) General Chemistry I



**Figure 7a: Relationship between Study Frequency and Participation in TaDDEI Workshops - Student (With GPA between 2.0 and 2.49) Perception (First Semester 1997- 1998) General Chemistry I.** Between participant and non-participants of TaDDEI (With GPA between 2.0 and 2.49), the percentage of General Chemistry I students who studied several times weekly was compared with the percentage of students who only studied before exams. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all General Chemistry I course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. An increase in the percentage of General Chemistry I students with a GPA between 2.0 and 2.49 who studied several times weekly and a concomitant decrease in the percentage of students who only studied before exams is observed in the TaDDEI participants when compared to the non-participants.

Relationship between Study Frequency and Participation in TaDDEI Workshops - Student (With GPA between 2.0 and 2.49) Perception (First Semester 1997- 1998) General Chemistry II



**Figure 7b: Relationship between Study Frequency and Participation in TaDDEI Workshops - Student (With GPA between 2.0 and 2.49) Perception (First Semester 1997- 1998) General Chemistry II.** Between participant and non-participants of TaDDEI (With GPA between 2.0 and 2.49), the percentage of General Chemistry II students who studied several times weekly was compared with the percentage of students who only studied before exams. Participation in the TaDDEI project is defined as attendance in at least 50% of the sponsored activities. Information used in this analysis was obtained from official class lists of all General Chemistry II course sections with the final grade for each student as well as lists of student attendance for the TaDDEI workshops and support groups. A very small sample size was obtained. All non-participants in TaDDEI with a GPA between 2.0 and 2.49 only studied before exams.

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