

AC 2009-754: STRUCTURED WORKSHOPS FOR TEACHERS TO FACILITATE IMPLEMENTATION OF "ALIMENTOS DIVERTIDOS", AN INQUIRY-BASED FOOD SCIENCE AND ENGINEERING P-12 PROGRAM

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Structured Workshops for Teachers to Facilitate Implementation of *Alimentos Divertidos*, an Inquiry-based Food Science and Engineering P-12 Program

Abstract

Alimentos Divertidos is an inquiry-based science and engineering program for P-12 students. To promote the experiments and encourage implementation of *Alimentos Divertidos* in schools, our faculty presented workshops at a regional conference on September 2007 and 2008. Around 250 and 280 (in 2007 and 2008, respectively) teachers from the state of Quintana Roo (Mexico) were engaged in a 3-day summer conference, during which they attended several distinguished lectures and seminars including *How People Learn*, and a workshop where they performed and learned how to teach five *Alimentos Divertidos* experiments and an engineering teaching kit (ETK), using foods as tools to facilitate engineering and science learning.

Information to report workshop outcomes was obtained from observational and interview field notes from the formal sessions, participant workshop evaluations and an *Alimentos Divertidos* exit survey. Responses to the survey indicated that the workshop was successful in preparing teachers and encouraging adoption of the experiments and the ETK in classrooms. More than 200 attendees completed surveys each year. Most teachers agreed that the experiments and the ETK are interesting and useful. In general, attendees rated them as good or excellent and felt very or somewhat comfortable performing and teaching the experiments and the ETK after the workshop. More than 88% of the teachers plan to use the experiment *discovering papillae* in their classes; 74% the experiment *color effect on sensory preference*, 83% the experiment *effect of seeing and smell senses on identifying food flavors*, 82% the experiment *effect of selected substrates on yeast activity through gas formation*, and 59% plan to use experiment *fingerprints and microorganisms* in their classrooms while more than 75% of the teachers plan to use the ETK entitled *the floating egg*.

More than 90% of Pre-school and Elementary teachers plan to use two or three experiments and the ETK in their classes, while 70% of Middle and High School teachers will use only one or two and the ETK. The written material provided for all the experiments was rated as very helpful. Suggestions for improvement include: funds, materials, more preparation time, follow-up worksheets to copy and hand out to students, and lists for materials (including suppliers).

Introduction

Universidad de las Américas Puebla (UDLAP) is a Mexican private institution of higher learning committed to first-class teaching, public service, research and learning in a wide range of academic disciplines including economics, business administration, the physical and social sciences, engineering, humanities, and the arts. UDLAP places a high priority on reaching out to its local community. Such outreach fosters service opportunities so P-12 students can discover science, engineering, and technology careers. Service is a fundamental aspect of being a professional and thus fundamental to our students' education.

UDLAP's *Alimentos Divertidos* is an inquiry-based science²³ and engineering program for P-12 students. We have developed, implemented and evaluated educational materials (simple and inexpensive experiments that utilize easy-to-obtain materials) and pedagogical practices designed jointly with P-12 teachers¹⁶. An Internet page with most of the developed materials (in Spanish) is available (<http://hosting.udlap.mx/profesores/enrique.palou/alimentosDivertidos>). *Alimentos Divertidos* major goal is to transform how students view, think about, understand, apply and do science and engineering. Among program objectives are to develop, implement, and evaluate: a) educational materials, b) pedagogical practices designed jointly with elementary school teachers, c) workshops designed to help teachers incorporate the experiments and pedagogical practices, and d) teacher learning communities; as well as to apply and evaluate the use of foods as a tool to facilitate engineering and science learning.

Among the elementary schools that are strongly involved in the program are two urban private schools, one within the *International Baccalaureate* program (*Colegio Americano*) in Puebla while the other is a "traditional" elementary school (*Instituto Miguel de Cervantes*) in Cholula; a sub-urban private school within the *Montessori* program (*Montessori Cholloyan*) also in Cholula, as well as urban and sub-urban public schools in Mexico City (*Escuela República de Irak* in Iztapalapa; *Escuela Miguel Alemán* in Milpa Alta; and *Escuela República de Checoslovaquia* in Coyoacán).

Alimentos Divertidos can be incorporated to P-12 science classrooms without modifying the existing curriculum at the different types and modalities offered at these levels in Mexico¹⁶. Our program is fostering that kids learn science and engineering DOING science and engineering. In the majority of school classrooms learning is evaluated through answers to the question ¿What do you know about ...? Our program additionally emphasizes another question, ¿How do you know it? Demonstrations can illustrate us what we know, but experiments show us how we know it. *Alimentos Divertidos* is developing EXPERIMENTS^{10, 12, 22, 25} and ENGINEERING TEACHING KITS^{11, 18, 19}, not demonstrations. In a demonstration (protocol or recipe) you follow a linear path of instructions, there is only one treatment. In an experiment, two "things" are performed in parallel; there are two treatments, two "things" that differ in only one factor. Thus, any difference in the result can be attributed to the difference in treatments²⁵.

Formative evaluations^{3, 4} (performed two times a year since the program started in 2004) with students and teachers have consistently shown that among *Alimentos Divertidos* educational benefits are: *Hands-on, minds-on learning models*, students work in teams to complete laboratory exercises to learn engineering and science principles; *Learning that science and engineering are fun career fields*, addressing national and international studies^{2, 20} showing that interest in engineering and science can be enhanced during P-12 school years; *Breaking down barriers*, students of diverse ages, gender, ethnic and economic backgrounds, and academic skill levels come together to exchange ideas on how to solve a science experiment or engineering design. They also learn that there are other students interested in becoming engineers and/or scientists.

Results to date indicate the importance of placing teachers in the role of "students" and allowing them to experience *hands-on and minds-on inquiry-based activities* as well as grapple with designing their own lesson plans in a peer group setting where they can brainstorm and receive

feedback. Therefore annually we hold on-campus one-week summer workshops in order to help elementary school teachers incorporate the developed experiments, ETKs and pedagogical practices^{5,8,15}.

Workshops

To further promote the experiments and engineering teaching kits, and encourage implementation of *Alimentos Divertidos* in schools in other states, our faculty presented workshops at a regional conference on September 2007 and 2008. Around 250 and 280 (in 2007 and 2008, respectively) teachers from the state of Quintana Roo (Mexico) were engaged in a 3-day summer conference, during which they attended several distinguished lectures and seminars including the *How People Learn* framework^{6,7,17}, active and cooperative learning¹³, and a workshop where they performed and learned how to teach five *Alimentos Divertidos* experiments and an engineering teaching kit (ETK), using foods as tools to facilitate engineering and science learning.

For over 10 years, professors from UDLAP have been working with the company *Calizas Industriales del Carmen* (CALICA) on a community service project whose main objective is to provide teacher development programs at an annual regional conference (sponsored by CALICA) in the state of Quintana Roo. These programs involve offering for 3 days, distinguished lectures, seminars, and workshops at no cost to teachers in attendance. The program designed for each conference is always different and includes recent educational developments. Workshops offer practical tools to the teachers in order to help them enhance their daily teaching activities, and different areas have been covered including math, history, Spanish, foreign languages, literature, science, engineering, among others.

The following experiments^{12,16} (planned to follow a guided-inquiry procedure²³) were included in the 2007 workshop: (1) *Discovering papillae*, identify tongue different papillae and their relation with the taste-sense; (2) *Color effect on sensory preference*, evaluate the effect of color on other attributes using sensory scales; (3) *Effect of seeing and smell senses on identifying food flavors*, evaluate the effect of other senses on taste, identify food flavor and score responses; (4) *Effect of selected substrates on yeast activity through gas formation*, evaluate and quantify gas formation (using a balloon to entrap gas) as a result of yeast activity consuming different sugars or substrates; and (5) *Fingerprints and microorganisms*, evaluate and quantify the number of microorganisms on fingerprints before and after washing hands or using selected disinfectants. In the 2008 workshop was introduced to the teachers an ETK entitled *the floating egg* as a set of lesson plans centered on density and buoyancy concepts, and an engineering design challenge that requires teams of students to use those concepts to design and formulate a sugar and salt solution of minimal cost in which an egg has to float. Student teams compete against each other. Thus the ETK approach involves hands-on, inquiry based, team oriented projects.

Information to report workshop outcomes was obtained from observational and interview field notes from the formal sessions, participant workshop evaluations and an *Alimentos Divertidos* exit survey^{1,9,14,21,24}. Interviews to gain insights from actual experiences of selected teachers (two per year) after implementing the workshop experiments in their classrooms were performed 4 months after the workshops.

Results and Discussion

More than 200 attendees completed workshop evaluations and *Alimentos Divertidos* exit surveys each year. Mean grades assigned by attendees were greater than 9.46/10 for both workshops evaluations, which include facilitators' knowledge, teaching ability, use of sound pedagogical methods and techniques, encouragement of attendee's active participation, interaction with the attendees, as well as an overall assessment of facilitators. Figure 1 presents the school grade in which workshop participants teach, being predominantly elementary and middle school teachers. Female teachers accounted for around 65% of workshop participants in both years. Figure 2 presents attendee's years of teaching experience; around 35% have taught for 5 years or less, and close to 20% have over 15 years of teaching experience.

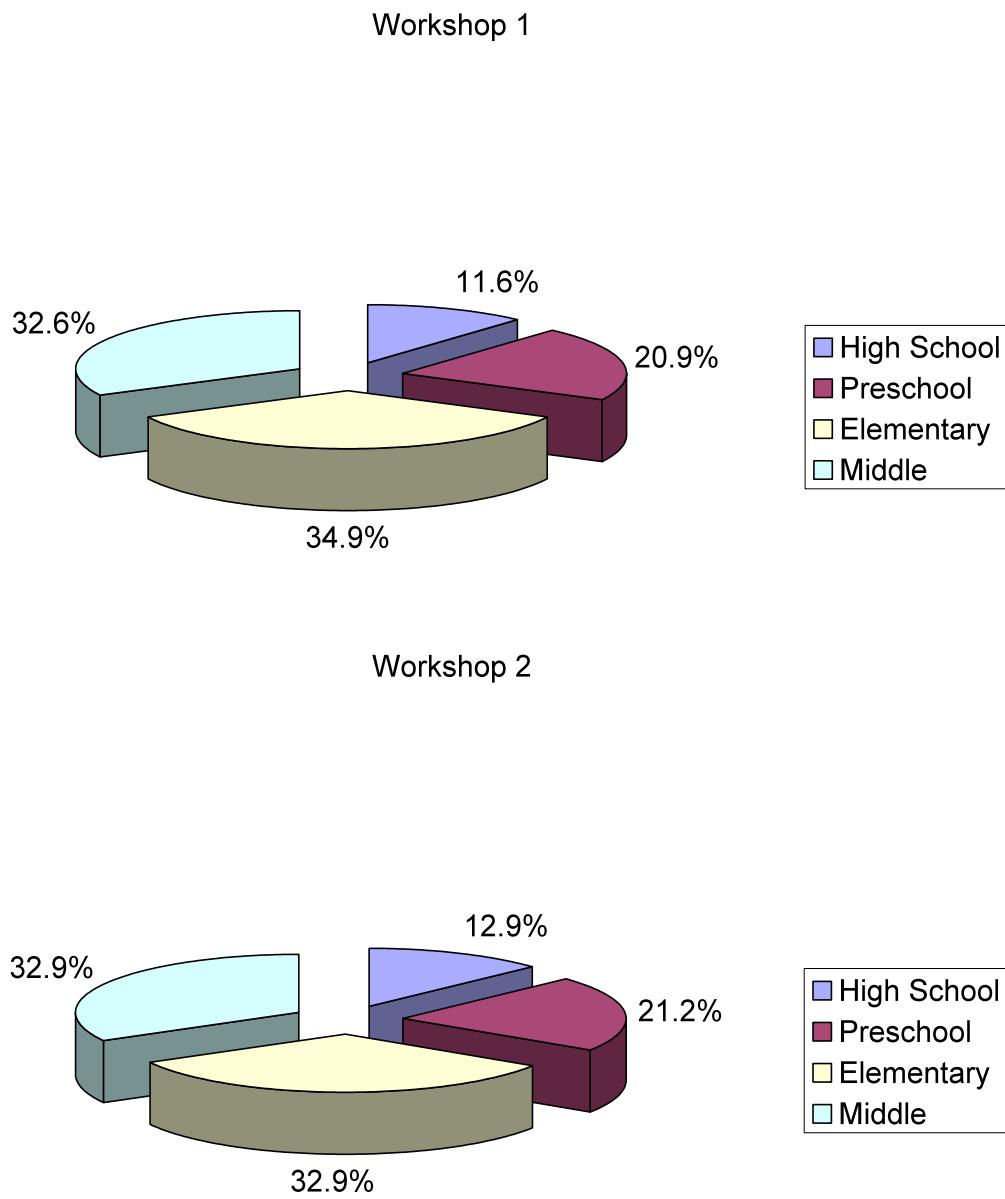


Figure 1. Participants by grade in which they teach. Workshop 1 was held in 2007 and workshop 2 in 2008.

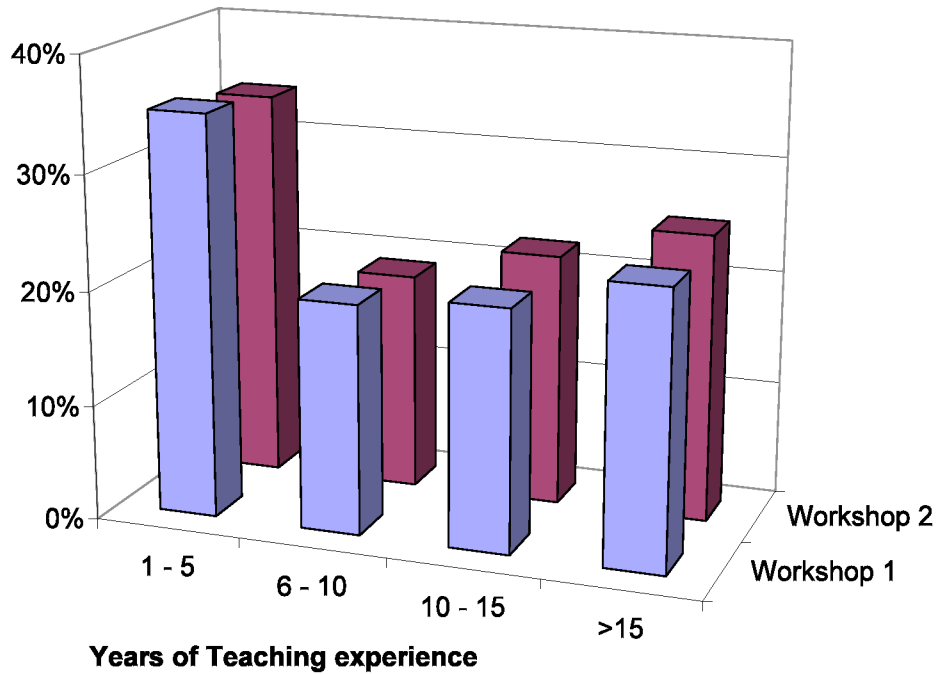


Figure 2. Participants by teaching experience. Workshop 1 was held in 2007 and workshop 2 in 2008.

Figure 3 illustrates the responses of the participants to general questions regarding the workshop. The responses were uniformly positive, most participants ‘Strongly Agree’ with the following statements: 1) I would recommend this workshop to other teachers, 2) the strategies presented in the lessons will promote their inclusion in my class, and 3) the materials were helpful resources.

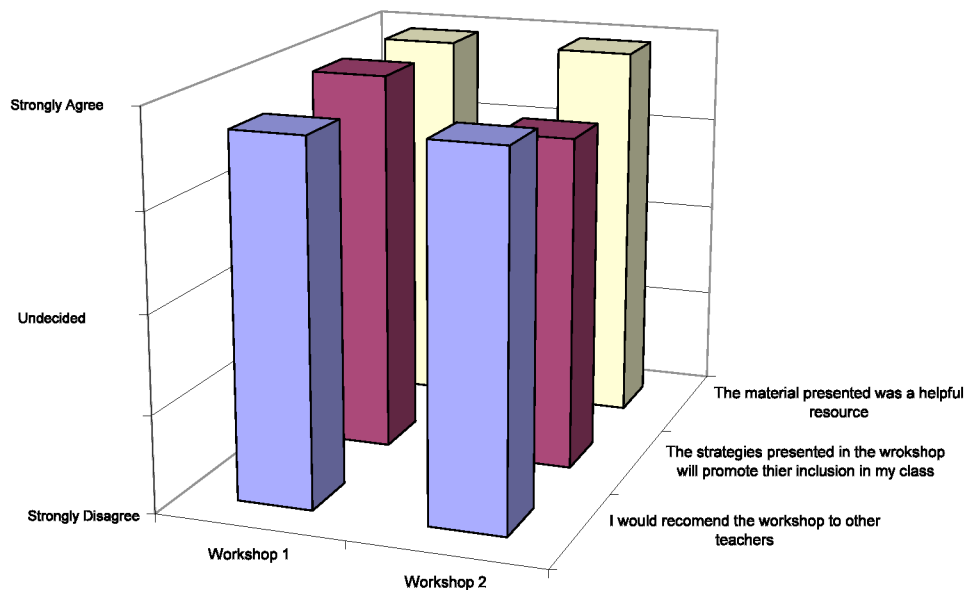


Figure 3. General questions regarding workshops. Workshop 1 was held in 2007 and workshop 2 in 2008.

Responses to the exit survey indicated that the workshop was successful in preparing teachers and encouraging adoption of the experiments and the ETK in classrooms. Most teachers agreed that the experiments and the ETK are interesting and useful. In general, attendees rated them as good or excellent and felt very comfortable performing and teaching the experiments after the workshop as can be seen in Figure 4. Teachers felt very or somewhat comfortable performing and teaching the ETK after the workshop (data not shown).

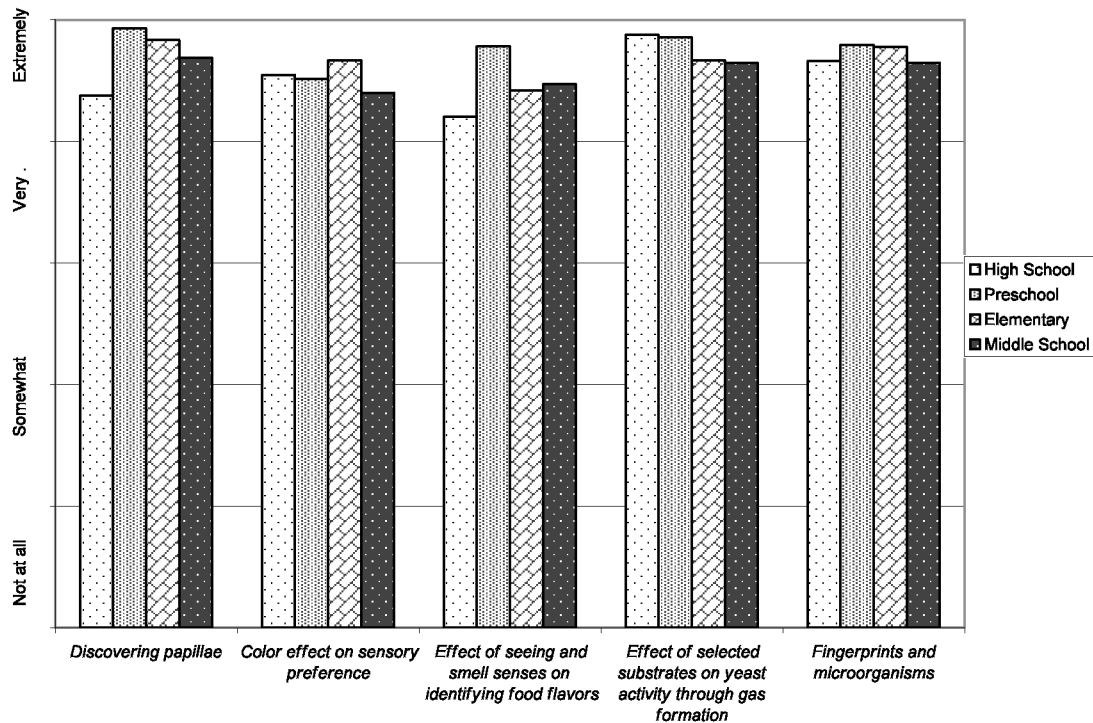


Figure 4. Teacher confidence in applying the experiments in his/her classroom.

All teachers strongly agreed that every one of the experiments and the ETK promote inquiry and enhance creative and critical thinking. More than 88% of the teachers plan to use experiment (1) in their classes; 74% experiment (2), 83% experiment (3), 82% experiment (4), and 59% plan to use experiment (5) in their classrooms while more than 75% of the teachers plan to use the ETK. More than 90% of Pre-school and Elementary teachers plan to use two or three experiments and the ETK in their classes, while 70% of Middle and High School teachers will use only one or two and the ETK. The written material provided for all the experiments was rated as very helpful. Suggestions for improvement include: funds, materials, more preparation time, follow-up worksheets to copy and hand out to students, and lists for materials (including suppliers).

Interviews to gain insights from actual experiences of selected teachers after implementing the workshop experiments in their classrooms were performed 4 months after the workshops. Two of

them teach Mathematics in sixth grade (last year of elementary school in Mexico), while the other two teach Biology and Chemistry in middle school. Every interviewed teacher attended the 2007 and 2008 workshops, and has implemented *Alimentos Divertidos* in his/her classroom.

Elementary teachers put into practice the experiments *Discovering papillae*, *Color effect on sensory preference*, and *Effect of seeing and smell senses on identifying food flavors* to motivate their students and use the data obtained to learn math in a fun way. Students were having so much fun with the experiments that they didn't realize the moment when they started learning to apply mathematics. Middle school teachers utilized in addition the experiment *Fingerprints and microorganisms* in which they took samples from different school places. Teachers asked the students to bring the materials necessary for the experiments, and told us that one of the advantages of *Alimentos Divertidos* is that experiments utilize easy-to-obtain, simple and inexpensive materials. Although sometimes the teachers consider materials even less costly and easier of obtain.

When asking them about student response, teachers mentioned that students were having much fun and that they enjoyed the experiments; but at the same time teachers felt they achieved the planned learning outcomes while providing significant learning experiences for their students. Also, it was mentioned several times that students participated in more active ways in their class sessions. Teachers stated that besides applying the experiments as they learned in the workshops, they had ventured themselves to implement other experiments using foods in their classrooms. For example, one math teacher prepared hot cakes in a class and motivated the students to calculate necessary grams of each ingredient, for different number of guests.

As far as the workshop materials that were distributed to them in order to implement the experiments, teachers mentioned that it was excellent, could follow it easily and that they did not had problems to understand it and apply it. The distinguished lectures, seminars, and workshops presented them to new forms to teach and learn, and help them with ideas from which they can devise new experiments, ETKs, teaching techniques, etc. Further, conferences motivated them to grow professionally and become even more qualified; two of them are pursuing graduate degrees as a result of this motivation.

Final Remarks

Workshops provided participants with opportunities to interact more closely and to develop strong interpersonal relationships, which are widely appreciated aspects of our program and valued highly by the P-12 teachers. *Alimentos Divertidos* is bringing about a true community of learners where we learn from the experience and shared information as much as or even more than P-12 students and teachers.

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