

Oficina Desafío – Challenging the Creativity

Marcelo Firer

Periscópio - Museu Exploratório de Ciências – UNICAMP – Brazil

mfirer@ime.unicamp.br

<http://www.mc.unicamp.br/desafio>

Key Words: Non-Formal Education, Problem Solving, Engineering Popularization

Oficina Desafio, Challenge Workshop, is a project of Periscópio – the Science Center of the State University of Campinas (Brazil). It is an outreach project, consisting of a full equipped mobile workshop constructed on a truck, that visits schools and presents the students an open solution real problem and challenge them to “design, construct and operate a device” capable of solving the challenge. It is designed to stimulate creativity in solving problems, team-working and the satisfaction of creating-building concrete objects.

The main aimed audience is students from 5th grade on, including adult students that go to night-school.

The project count with fifty monitors, all of them university students, trained in practical routines and introduced to content aspects, and each event is undertaken b a team of six of those students, responsible for operating the electric tools, organizing the event and advising the students.

Each event is capable to attend up to 80 students and last about four and a half hours, including the physical organization of space, dividing students into teams (ten), presenting the challenge, developing the solution (about 2.5 working hours), presentation of the student’s works and symbolic award ceremony.

Beside the challenges done with students at school, the last Saturday of every month is devoted for teacher’s clinics, where they can experience a challenge and discuss possibilities for echoing the challenge at their regular work at school.

In its first five months of activity, Oficina Desafio was able to make more then fifty challenges, in ten different cities in four states of Brazil, working with more then 2500 people.

Oficina Desafio has a large system of documentation, including evaluation forms answered by school students and their teachers at every single event, reports made by the university staff and many hours of videos. First systematic analysis of the evaluation forms shows what is easy to perceive to every one that whiten the challenge: they enjoy it. We support this statement observing that the major complaint of the participants (65% of those that answered the question “what you liked less or did not like in the event organized by Oficina Desafio”) concerns the lack of time. Besides the joy, we can say that they look at the challenge as a learning opportunity: When asked to chose a person to take part at the team, 70% of the teams that answered the question explained their choice with arguments related to knowledge, with typical answers like: “Because she thinks”, “Because he is a physics teacher”, “Because he likes to teach in unusual fashions”.

Oficina Desafio, Challenge Workshop, is a project of Periscópio – the Science Center of the State University of Campinas - UNICAMP (Brazil). It is an outreach program, consisting of a fully equipped mobile workshop constructed on a truck, that visits schools and presents the students a real problem with open ended solution and challenge them to “design, construct and operate a device” capable of solving the problem¹.

The project has a large spectrum of activities, including workshops and other kind of support for teachers, but we focus the attention on the work done directly by student's teams, that has two major variations, which we describe briefly.

The “**Big Challenge**” (Grande Desafio) is a competition, which first edition was launched last March, and students will have up to three month to work within small teams and develop their solution. This program ends with an presentation event where all the teams presents their projects, operating the device in an official competition arena, presents the development process as a whole, are evaluated based on both this items and many prizes are given teams with outstanding performance in many criteria. This program is strongly inspired and adapted from The Tech's Challenge that is now undergoing its 20th edition and strongly supported our team. The presentation event of this firs Big Challenge program will take place at June 17th 2007.

The second major variation is the “**Small Challenges**” (Pequenos Desafios), so called because those are similar activities that designed to take place at school and to directly enroll students for one single day. The mobile workshop, that supports activities of the Big Challenge, has a central role in the Small Challenges. The truck itself has a central workshop equipped with electrical machinery and a small office. Besides that, it carries equipment for ten small working stations, equipped with a working bench and a tool chart. It arrives at school with a team of six monitors (undergraduate students that joined a 40 hours training program) and the truck driver. Within half an hour all the equipment is ready for use. The student are divided into up to ten teams (5 to 8 members each), from a small stage in the truck the coordinator monitor presents the challenge and the teams work on a solution for about two and a half hours, operate the devices and explain the main ideas, the awards are given, the mobile workshop is packed up and the event is over. It started its activities in August 2007 and made more then 50 events in 2007.

Despite the evident difference in the development of both activities, mainly in the rhythm and consequent depth of engagement, both kind of challenges share the same overall goals, that are reflected in the judging criteria used for giving the awards: *Creativity* in the search of solutions to the presented problem, the use of different

material, *Design Process* that includes planning and documentation, testing and improving process, and a *Team Work* that makes of every team member an actual partner of the project.

Besides these common goals and the propaedeutic goal of stimulating the participation of students in the Big Challenge, the Small Challenges program has an important characteristic that open opportunities and imposes some proper objectives.

The arrival of the mobile workshop at school is generally an event per itself, since it is big, has a bold and unique design and there are very few complementary projects that reach school within its buildings and walls. Also, the small challenge engages entire school classes (two classes per event) and not single individuals. The fact that the whole school is aware of the event and that teacher has classes that took part in it as a collective, opens opportunities for teachers to develop other activities that refers to this experience, exploring the science/math contents that emerges from the solutions and other curricular contents that arises from the problem situation. Moreover, it purpose a methodological approach that is very consonant with the general (constructivist) directives of Brazil's Ministry of Education, elaborated in the 1990's, and originates much anguish among school teachers. This kind of anguish is predictable when moving from content centered teaching attitudes to problem-solving context as described in theoretical literature, for example in Perrenoud's discussion about changes in learning assessment imposed by changes in school programs and approach² and somehow recognized also by educational authorities³. Aware of this situation, the Science Center team makes efforts to support the teachers' activities that explore the problems and questions that arise from small challenges, organizing workshops and clinics and providing discussion groups. However, the basic premise underlying the Workshop Challenge program is that *the challenges developed at school provide the students a significant experience that is recognized as a learning opportunity*. This is the major question we face in what follows and try to give enough evidences to support our answer.

The primary source of information is the questionnaires answered by the students. This is only part of the information gathered for evaluation and documentation of the work, and we will not take into consideration for this analysis the data that emerges from teachers questionnaires and monitors reports, but of course. At the end of every “Small Challenge” the participants are asked to answer a detailed questionnaire, which is answered collectively by each team. The collected data refers to 252 teams answers, representing about 1688 individuals that took part in the challenges between July and November 2007.

The forms has more then 20 questions, most of them open questions, and it plays an important role in the formative evaluation of the project, leading already to some substantial changes and improvements. Moreover, it gives some substantial support for summative evaluation, concerning not only the well execution of the work, but facing the crucial question of indeed having the cultural/educational/scientific expected “performance”. This last aspect is our concern here, so most of the questions, that has a technical interest, are ignored, and we look for the answer to the following questions:

1. What did you like most in the Challenge Workshop⁴?
2. What did you liked not in the Challenge Workshop?
3. Does your team think that the challenge presented to you was a tight challenge, neither too difficult nor easy?
4. If you could elect someone (adult or youth) to join your team, who would you choose? What is his/her occupation (profession)? Why have you chosen this person?

All this are open-ended questions, and the answers to each one were separated in few different categories. This is not a taxonomy, there is no hierarchical relation between those categories, and they were determined to identify the perception of participant students have form the “Small Challenges” and to support formative evaluation of the program ⁵.

In what follows we describe and analyze the answers to each question separately and end with an overview. For each question we first present the classifications and resume each with a few sample answers.

1. What did you like most in the Challenge Workshop?

The answers to this question were classified into four categories:

Contents and creativity: This category is actually a positive answer to our leading question and so, classification in this category must be careful. Only answers that expressed the contentment using explicitly words as creativity, experience, learning, imagination and ideas were considered to be relevant. Typical answers to this category are: *“The Challenge itself, to build an equipment to solve the problem using creativity and intelligence”*; *“The use of practical knowledge we already had and acquiring new ones”*; *“The opportunity of thinking”*.

Material facilities: Answers that refer to the tools and machinery provided, the workshop itself, the material and parts they could use. Typical answers to this category are: *“Availability of equipment”*; *“working with carpentry”*; *“Opportunity of building things with our own hands”*.

Team working: Many times presented in contrast to the usual class activities organization. Typical answers to this category are: *“Team working”*; *“The interaction between the individual and the collective”*; *“The union of our team”*.

Monitors: The guidance and orientation of the monitors, including help in the use of tools and machinery. Typical answers to this category are: *“The hospitality of the monitors”*; *The monitors, specially the girls from Social Science and Biology*, *The attention and the care of the monitors”*

2. What you did not like in the Challenge Workshop?

Since the answers to this questions found to be relevant both to the formative and the summative evaluation, the answers are classified into more categories. The first

three concerns the technical conditions found at school or provides by the Mobile Workshop:

Insolation: The absence of a shadowed area where the workshop could park made the students work under sometimes very hot weather conditions.

Drinking and food problems: Many times the place where the challenge took place was distant from usual school facilities.

Lack of parts or tools: Complaints about tools and parts the teams wanted to use and were not available.

The next five items concerns the working process and organization:

Team working: Problems with the personal relations in the group or team working organization. Typical answers to this category are: *“Sometimes the disorganization of the team....”*; *“From certain people in the group”*; *“The disagreement”*.

Lack of time: Not enough time to construct the project as it was designed. Typical answers to this category are: *“Lack of time”*; *“Not enough time to accomplish the challenge”*; *“Time was short and we couldn’t finish the work”*

Failure of the project: Complaint about the failure of the device to accomplish the task it was challenged to do. Typical answers to this category are: *“It didn’t work!”*; *“We had good ideas but had no time to conclude them, so it wasn’t productive”*; *“It took time and the machine failed and didn’t work”*

Organization Problems: Problems concerning the space organization, the monitors work, device presentation, line for using machinery. Typical answers to this category are: *“To share the monitor with another team”*; *“relation of the team with the monitor”*; *“We didn’t have enough information”*.

General discontentment: Discontentment with aspect essential (and hence unavoidable) of the project, such as operating tools, team working, planning. Typical answers to this category are: *“Of what we had to do”*; *“Working”*; *“Using the hammer”*.

3. Does your team think that the challenge presented to you was a tight challenge, neither too difficult nor easy?

This is actually a question with only two possible answers (yes or no), but necessary to find out the adequacy of the challenge, what turns to be essential when considering the intent to turn it into a learning opportunity.

4. If you could elect someone (adult or youth) to join your team, who would you choose? What is his/her occupation (profession)? Why have you chosen this person?

This last question in the form aims to understand what kind of knowledge, skills or competencies the students identify with the activity they just did. There are three categories, the first one identified with the *challenge* itself, the second with the *workshop* and the third with *team-working*, the three main components of the Challenge Project.

Content-related contribution: Into this category were classified all answers that pointed out intellectual knowledge and or skills, inferred either from the profession indicated (engineer, scientist), some general ability (has good ideas, know how to solve problems), or some specific knowledge (knows to teach robotics). Typical answers to this category are: *“He is an architect and has skills in making projects”*; *“He is a teacher ... since he is very intelligent and solve stuff quickly”*; *“Isaac Newton, because he has a large knowledge of mechanics”*.

Manual skills: Identified either by explicit statements (know how to use tools), or inferred from the person occupation (carpenter). Typical answers to this category are: *“He is an electric engineer and he is very good with carpentry”*; *“He is a teacher and has ability in using tools”*.

Social contribution: Personal qualities that the group enjoy or can contribute to team-working. Typical answers to this category are: “

Typical answers to the categories, as much as the distribution of answers are given in the tables bellow. *Because he is nice”*; *Because she is up and would like the activity”*; *“She is a student, she helps us, she is cool and creates a nice feeling to all”*.

We now present the distribution of answers to each of the questions.

The distribution of the answers to this question is resumed in the tables bellow.

	Contents and Creativity	Material Facilities	Team working	Monitors	Other	No answer	More than one answer
Total	125	86	48	26	26	11	60
Percentage	50%	34%	19%	10%	10%	4%	24%
Percentage of answered questionnaires	52%	36%	20%	11%	11%		25%

Table 1: Distribution of answers for question 1

	Insolation	Drink and Food	Lack of parts or tools	Team Working	Lack of Time	Failure of the Project	Organization Problems	General Discontentment	Other	More than one answer	No answer
Absolute Num.	41	6	21	10	72	13	10	15	23	24	71
Percentage	16%	2%	8%	4%	29%	5%	4%	6%	9%	10%	28%
Percentage of answered questionnaires	23%	3%	12%	6%	40%	7%	6%	8%	13%	13%	

Table 2: Distribution of answers for question 2. There are answers classified into more then one category.

	Adequate	Not adequate	No answer
Absolute Num.	211	29	12
Percentage	84%	12%	5%
Percentage of answered questionnaires	88%	12%	

Table 3: Distribution of answers for question 3

	Content-related contribution	Manual skills	Social contribution	Others	No answer
Absolute Num.	80	15	31	17	121
Percentage	32%	6%	12%	7%	48%
Percentage of answered questionnaires	61%	11%	24%	13%	

Table 4: Distribution of answers for question 4. There are answers classified into more then one category.

Comparison between the answers to the first two questions shows a general contentment of the participants: When asked about what they *did* like, only 4% gave no answer and about 24% answered with more than one item, comparing to 28% that gave no answer and 10% that gave more than two answers when asked about what they *did not* like. Moreover, great part of the discontentment is due the lack of time, a faithful testimony of the engagement of students in work. This conclusion concerning the engagement of students is strengthened by the clear adequacy of the challenge proposed to teams (88% of the answers).

Satisfaction and moreover engagement are supported also by simple observation during the events at school. The picture bellow (left), showing students concentrated on their work stations, with the mobile workshop in the background, is a typical situation of the Small Challenges. In this context, the questionnaires are used only as evidence that supports what is already known.



Picture 1: Teams working at projects



Picture 2: Team presenting their device

However, the main question asked in this work, whether *the challenges developed at school provide the students an experience that is recognized as a learning opportunity* is more subtle and observational data can be misleading, since we are trying to understand a perception that does not involve any physical action. At this point the answers to questions 1 and 4 are elucidative.

The classification of the answers to both these questions took into consideration the three major components of this program, namely: 1) The challenge to solve a problem; 2) Building a device in the workshop; and 3) Doing that as a team.

The answers to the first question shows that about half of the students (52% of the answers) enjoyed the event mainly because the challenge itself. Moreover, most students (61% of the answers) recognized that the knowledge of contents and general capability for problem solving are the main characteristics needed to succeed in the challenge.

All those answers allow us to conclude by a positive answer: *Yes, students do have a significant experience that is recognized as a learning opportunity.*

At last, we remark that students perception of this activity opens the possibility for teachers to engage students in other significant problem solving situations, to explore the contents that appear in the student’s devices, and use the visit of the Mobile Workshop as a starting point or an apex to their teaching programs. On the other hand, it enlarges the responsibility of the Science Center staff to encourage and support teacher’s engagement and development of class plans using such a “methodology”⁶.

¹ As a sample, we mention the problem of a pedestrian bridge connecting a neighborhood to the school block that was carried away by a flow, driving students to a 4 km walk in their way from home to school and the challenge of finding a solution until the authorities build a new one. Solutions vary from a rope bridge to a (working) catapult.

² Discussion about the anguish caused by changes in evaluation process starts at page 70 of Perenoud, P. *Avaliação: da excelência à regulação das aprendizagens: entre duas lógicas*. Porto Alegre: Artes Médicas, 1999

³ See for example program for in-service course sponsored by Goias State Education Authority, available at <http://educacao.go.gov.br/portal/supem/documentos/telesala03.pdf>

⁴ *Challenge Workshop*, Oficina Desafio in Portuguese, is the name of the project, stamped in the truck and with a linguistic nuance that refers equally to the “work” as to the “shop”, i.e., it focus both on the material structure and the activity.

⁵ A set of 30 answers were independently classified by two different persons, the values agreeing significantly (average correlation of 0.85) and this was considered as the basic validation for the classification of the given answers.

⁶ The experience of the *The Tech Museum of Innovation* shows that up to 90% of the teachers that take part in their teachers clinics adopt the “Challenge Methodology” at school. Details can be found in Design Challenge: Learning Through Problem Solving, in ASTC Dimension, September/October 2002.