DOCUMENT RESUME

ED 453 085	SE 064 946
AUTHOR	Dziedzic, Mauricio; Tozzi, Marcos; Traghetta, Dinis; Gomes, Julio; Kruger, Claudio
TITLE	First Engineering Games at UnicenP.
PUB DATE	2000-08-00
NOTE	6p.; Paper presented at the International Conference on Engineering Education (Taipei, Taiwan, August 14-16, 2000). Figures may not reproduce adequately. Contains small print.
PUB TYPE	Guides - Non-Classroom (055) -- Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Curriculum; *Educational Games; *Engineering Education; Foreign Countries; Higher Education; Interdisciplinary Approach; *Science Activities

ABSTRACT

UnicenP's First Engineering Games took place in October of 1999, and consisted of three tasks designed by engineering faculty which involved all courses taught in first year. Teams were made up of students from all four Engineering programs currently offered by the institution. The games occurred over a period of three days and proved a successful effort at introducing multidisciplinary events into the engineering curricula. (Author)

First Engineering Games at UnicenP

Maurício Dziedzic [1], Marcos Tozzi[2], Dinis Traghetta[3], Júlio Gomes[4] and Cláudio Krüger[5]

[1]Chair, Department of Civil Engineering, Centro Universitário Positivo – UnicenP, Curitiba, Brazil, http://www.unicenp.br
ASCE Member, Tel.(+55) 41 317-3035, Fax(+55) 41 317-3030, dziedzic@unicenp.br
[2]Dean, Faculty of Science and Technology, Centro Universitário Positivo – UnicenP, Curitiba, Brazil, http://www.unicenp.br
Tel.(+55) 41 317-3035, Fax(+55) 41 317-3030, tozzi@unicenp.br
[3]Department of Civil Engineering, Centro Universitário Positivo – UnicenP, Curitiba, Brazil, http://www.unicenp.br
Tel.(+55) 41 317-3035, Fax(+55) 41 317-3030, dinisgt@unicenp.br
[4]Department of Civil Engineering, Centro Universitário Positivo – UnicenP, Curitiba, Brazil, http://www.unicenp.br
Tel.(+55) 41 317-3035, Fax(+55) 41 317-3030, jgomes@unicenp.br
[5]Department of Civil Engineering, Centro Universitário Positivo – UnicenP, Curitiba, Brazil, http://www.unicenp.br
Tel.(+55) 41 317-3035, Fax(+55) 41 317-3030, kruger@unicenp.br

Abstract: UnicenP's First Engineering Games took place in October of 1999, and consisted of three tasks designed by engineering faculty which involved all courses taught in first year. Teams were made up of students from all four Engineering programs currently offered by the institution. The games occurred over a period of three days and proved a successful effort at introducing multidisciplinary events into the engineering curricula.

Keywords: Engineering games, multidisciplinary, teaching, UnicenP.

1. Introduction

The undergraduate engineering programs offered at UnicenP are Civil, Computer, Electrical, and Mechanical. Following a strong trend in contemporary education, Engineering faculty at UnicenP has been trying to promote multidisciplinary events. Thus, in October of 1999 took place our First Engineering Games, which consisted of three multidisciplinary tasks involving concepts studied during the freshman year.

The four engineering programs listed above are annual, with the freshman year being very similar in all cases. In the first year, courses common to the four programs are: Calculus, Linear Algebra and Analytic Geometry, Physics, Technological Chemistry, Engineering Design, and Computer Programming. In addition to these courses, Civil and Mechanical Engineering students also take Descriptive Geometry and Computer Aided Drawing. Program-specific disciplines taught in the first year in order to give the students a glimpse into their future professions are: Surveying for Civil Engineering, Logic for Computer Engineering, Electronics for Electrical Engineering, and Metrology for Mechanical Engineering.

The present paper concentrates on the description of task two of the 1999 event, with task one having been the subject of a similar paper [1] to be presented at the ICEE-FIE 2000 Conference.

2. Games Regulations

One day before the beginning of the games, the rules and regulations were distributed to the students and team composition was made known. These regulations consisted basically of the following points:

- the students were divided in 15 equally-skilled teams, based on their performance during the first semester. These teams were composed of students from the four programs, an aspect designed to impress upon the students the reality of working in multidisciplinary teams, a certainty in their future professional careers. Each team was assigned a different colour, with T-shirts of these colours being distributed to all participants and their use made compulsory. Modifications in the composition of the teams were not allowed during the event.;
- the technical part of the Engineering Games occurred over a period of 3 days, with 5 teams performing one of the tasks each morning. On day four, recreational activities were performed, which accounted for 15% of the final score. Marks received in the three technical tasks were included in all courses as 20% of the fourth quarter grade;
- at 7:30 hs, every morning, teams received instructions and equipment for the completion of that day's task;

- each team had to hand in a report by noon, which was analysed considering originality, correctness and speed. The inclusion, in this report, of team members noted not to have participated in the task would incur in the assignment of a null grade to the team;
- a maximum of three tips for each task could be acquired from the proctors (faculty members) at the expense of a 1.0 point deduction from the final mark for each tip acquired, where the maximum final mark possible was 10.0;
- the organising committee did not guarantee privacy of the teams during the performance of the tasks. Therefore, each team was responsible for guarding against possible "spies", since all tasks would be under execution concomitantly;
- students belonging to teams classified in first, second, and third place were awarded medals;
- plagiarism, interference with other team's work (sabotage), damage to equipment or installations, and excessive noise would lead to punishment in the form of mark deductions, and possible additional sanctions as predicted by prevailing regulations;
- the material distributed for the execution of each task should be utilised unmodified and in a non-destructive manner.

3. The Tasks

The three tasks of the First Engineering Games were designed in order to involve all courses taught during the freshman year, and already listed above. They also had to provide challenging, yet feasible, problems for the students. Table 1, below, shows the courses covered by each task, regarding course contents in first year. In this regard, task 3, for instance, which involves temperature measurements, would, in the broader sense, certainly involve Physics, but thermal sciences are only covered in second year Physics.

Table 1. Subject courses involved in each of the tree tasks devised for UnicenP's first engineering games.

Course	Task 1	Task 2	Task 3
Calculus		x	
Computer Programming	x	x	
Descriptive Geometry and Computer Aided Drawing	x		
Electronics	x		x
Engineering Design	x	x	x
Linear Algebra and Analytic Geometry	x		
Logic	x	x	x
Metrology	x		x
Physics		x	
Surveying	x		
Technological Chemistry			x

The first task involved the determination of an area demarcated in the front campus by colour-coded wooden stakes. Each of the five teams working on task 1 on a given day was assigned a certain stake colour, and had, as first part of the task, to locate the four stakes which demarcated a non-rectangular area on the terrain. The task called for the determination of the area by the four following methods: sub-division in triangles, inner product of vectors, double meridian distances, and use of a computer program developed by Civil Engineering students and provided to all teams with a few errors introduced. Also asked for was an analysis of the statistical uncertainty of the measurement processes adopted, and a detailed computer-aided drawing of the area being measured. Regular surveying equipment was not made available to the students, nor was its use permitted during the games. Figure 1 shows the general setting in which task 1 took place.

Figure 1. Blue team at work on task 1.

The second task was the determination of the moment of inertia of a homogeneous wooden cylinder of radius R and height h, along the longitudinal axis (z).

The moment of inertia I_z should be determined experimentally, analytically, and numerically. The experimental determination relied on the utilisation of:

- the rotating cylinder itself,
- mounted at the high end of a 1.50 m long inclined plane (shown in Figure 2);
- 2.0 m of string;
- one brick of known mass with a polished surface;
- one 2.0 m long measuring tape;
- a stopwatch.

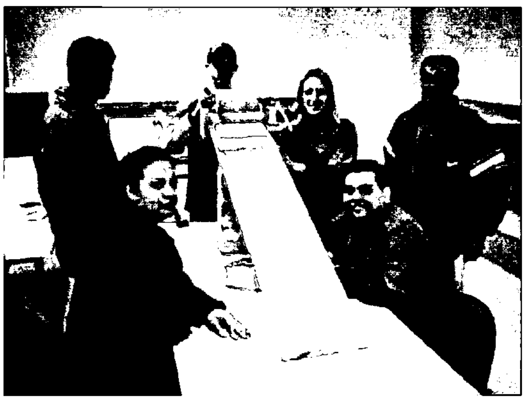

Figure 2. Members of the red team working on the experimental determination of the moment of inertia of a homogeneous wooden cylinder, as part of tas k 2.

The analytical determination of the moment of inertia relied on its theoretical definition and the solution of a simple integral, while the numerical determination involved the study of the extended trapezoidal rule [2], a subject not covered by the time the games took place, and the analysis and correction of a bug-filled computer program supplied.

In more detail, in the experimental part, the students were expected to indirectly determine the moment of inertia of the cylinder through the measurement of its angular acceleration when a block of known mass moved down the inclined plane shown in Figure 2. In order to do that, they were told to employ Newton's second law, in the scalar form, for rotation

$$F = ma \tag{1}$$

and translation

$$\tau = I_z \alpha \tag{2}$$

were F is the force acting on the block [N],
m is the mass of the block [kg],
a is the acceleration of the block [m/s^2],
τ is the torque applied on the cylinder [N.m],
I_z is the moment of inertia of the cylinder [$kg.m^2$],
and α is the angular acceleration of the cylinder [rad/s^2].

The torque, τ, which appears in equation (2), can be obtained through

$$\tau = TR \tag{3}$$

were T is the force applied by the string on the cylinder [N],
and R is radius of the cylinder [m].

The students were expected to find the force T, applied on the cylinder, by considering both the mass of the sliding block and its friction with the inclined plane. They were told to employ a dynamic friction coefficient, μ_d 25% lower than its static counterpart, μ_e, which had to be estimated experimentally.

In the theoretical part of the task one was expected to employ calculus principles and start with the definition of the moment of inertia

$$I_z = \int_0^R r^2 \, dm \tag{4}$$

in order to obtain

$$I_z = \frac{mR^2}{2} \tag{5}$$

The more common form of the moment of inertia, usually employed in strength of materials, can be obtained by transforming the mass integral, in equation (1), into a volume, or area, integral.

Finally, the computational part of task 2, contained a brief explanation of the extended trapezoidal rule for numerical integration [2], since the subject had not been covered by the time the games occurred, together with an algorithm

The third task called for the identification of a pure chemical compound, based on its boiling point, without the use of a thermometer. Figure 3 shows a group of students at work on the task.

4. Results

The completion of the tasks by the students was achieved in a very satisfactory way, notwithstanding the fact that the "ideal" solutions, as devised by the faculty members, were hardly approached. Much of the equipment distributed was put to uses which were not even imagined by the organisers, let alone predicted by the manufacturers.

Figure 3. Members of the green team working on the experimental determination of the boiling point of a chemical compound (task 3).

The quality of the results, however, was very satisfactory, and the general feeling among the faculty was that the students succeeded in solving the engineering problems posed.

5. Conclusions

Student response to the Engineering Games was overwhelmingly positive, not only because these games provided a welcome break from daily classroom activities, but mainly because the tasks gave the students a chance to apply in real life concepts learned during the year.

Participation in the games was not made compulsory, and absenteeism in the period was noticeably lower than during regular classes.

The events held on day four were of a more recreational nature, and included a treasure hunt, an egg-drop competition, a push-up competition, a joke tournament, and a barbecue.

The build-up of a team spirit and comradery among members of different teams and between students and professors was remarkable and is observed to have lasted past the duration of the games.

Even before the end of the games, most students were enquiring about the next games, which only served to reinforce the organizer's decision of making the Engineering Games a yearly affair at UnicenP.

6. Acknowledgements

The participation of the following individuals, listed here in alphabetical order, was fundamental in the planning and execution of the First Engineering Games: Prof. Edson Ferlin, Prof. Haine Jordan, Prof. Emerson Paraíso, Ms. Juliane Poletto, Prof. Júlio Nitsch, Prof. Marcos Rodacoski, and Prof. Sandra Alberti.

7. References

[1] Dziedzic, M., Tozzi, M., Ferlin, E., Rodacoski, M. and Nitsch, J., "Multidisplinary Engineering Programs at UnicenP". ICEE Frontiers In Education FIE 2000 Conference, Kansas City, Missouri, US, October 18-21, 2000.

[2] Press, W. H., Teukolsky, S.A., Vetterling, W. T., Flannery, B. P., "Numerical Recipes in C – The Art of Scientific Computing", Second Edition. Cambridge University Press, 1992, 994 pp.

SE064996

ERIC

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: First Engineering Games at UnicenP

Author(s): Dziedzic, M., Tozzi, M., Traghetta, D., Gomes, J., Krüger, C.

Corporate Source: The 2000 ICEE Conference Digest & ~~(Centro Universitário Positivo)~~ Conference Proceedings.

Publication Date: August, 2000

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2A documents	The sample sticker shown below will be affixed to all Level 2B documents
PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY ____ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY ____ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY ____ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
1	2A	2B
Level 1 X	Level 2A X	Level 2B X
Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) and paper copy.	Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only	Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here, please

Signature: [signature]	Printed Name/Position/Title: Mauricio Dziedzic / Chair of Civil Eng/Prof
Organization/Address: Centro Universitário Positivo, R. Prof. Pedro Viriato Parigot de Souza, 5300	Telephone: +55 41 3173036 FAX: +55 41 3173141
	E-Mail Address: dziedzic@unicenp.b Date: 29/06/2001

Curitiba - PR - Brazil
81280-330

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC S(JRCE):

If permission to reproduce is not granted to ERIC, *or*, if you wish ERIC to cite the availability of the documen 'om another source, please provide the following information regarding the availability of the document. (ERIC will not announce a c :ument unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selectior iteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor: Program
Address:
Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS IOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provid :he appropriate name and address:

Name: Program Committee of the 2000 Int'l Conf. on Eng. Education
Address: 1001 Ta Shieh Road, Center for Professional Advancement - ICEE2000, National Chiao Tung University, Hsinchu, 300, Taiwan, ROC (Fax.+886-3-5721431)

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

ERIC/CSMEE
1929 Kenny Road
Columbus, OH 43210-1080
E-mail: beckrum.1@osu.edu
FAX: 614-292-0263