Revista Brasileira de Física, Vol. 3, N.° 1, 1973

Teaching Physics without "in Class" Exams*

T. A. E. C. PRATT

Instituto de Fisica, Universidade Federal do Rio de Janeiro: Rio de Janeiro, GB

Recebido em 13 de Fevereiro de 1973

An experiment is described in the teaching of physics without giving "in class" exams. The study involves 5 classes – 4 in U.S.A. and 1 in Brazil – covering students who are undergraduate non-majors in physics, undergraduate majors in physics and graduates in physics Various comments of Brazilian students are included in the discussion of the apparent limitations of the two methods – the conventional "in class" exam procedure and this experiment The main conclusion is that students to not like "in class" exams and that the Brazilian Post Graduante students feel that "in class" exams do not make them feel respected and are not the best indicators of their real abilities.

Descreve-se uma experiência no ensino de Física sem exames feitos em classe. O estudo envolve 5 turmas – 4 nos Estados Unidos e uma no Brasil O estudo cobre estudantes graduados matriculados em Fisica e em outras carreiras e estudantes graduados matriculados em Física Incluem-se vários comentários de estudantes brasileiros comparando as aparentes limitações do presente método e do método tradicional com exames feitos em classe. A conclusão principal é que os estudantes não gostam dos exames feitos em classe é que os estudantes graduados brasileiros sentem que os exames em classe são um desrespeito para com eles e não medem suas reais habilidades.

1. Introduction

The basic nature of an exam involves two aspects: who sets the exarn and for whom. There is actually a third aspect which unifies the previous two and that is what is the exam used for. Generally, in schools, it is assumed that the exam is to find out if the students are studying or have learnt the material. This idea might be extended by the professor to also find out how brilliant or clever are the students.

If the students and professor fall in the same group of thinking then there is no problem about the exam and a difficult exam is looked at by the students as challenging even though their grades might be at stake.

---

*A shorter version of this paper was first presented at the *II Simpósio Nacional de Ensino de Física (Sociedade Brasileira de Física)* at Belo Horizonte. January. 1973.

'Postal Address: Cidade Universitária. Ilha do Fundão. 20000 - Rio de Janeiro GB.

However, what is generally found in the classroom is a group of students variously and diversly motivated, more prone or enthusiatic to be a participant in every aspect of the course, especially the grade which might determine their life. With this background, one general criticism is that the "in class" exam (apart from the pressure and stress it puts on the students) does not indicate what the studenis feel they know of the course. In this matter, one important variable is time. From the professor's point of view, the students who did not score well might not have spent enough time whiie from the student's point of view – "I spent a lot of time in this course at the expense of the other courses and yet did not get a good grade or even a passing grade".

In an attempt to solve this problem, the "in class" exam was done away with. The following alternative program was followed and emphasis will be put on the discussion of its application in Brazil in this paper.

2. Description of the Program

a) General

The following classes experienced this program over a period of 4 semesters:
1. ***General physics without Calculus*** – Introduction physics to non physics majors.
2. ***General physics with Calculus*** – Introduction physics to undergraduates basically interested in physics.
3. ***Modern Physics*** – Physics for undergraduate majors.
4. ***Quantum Mechanics*** – Physics for graduates and undergraduates.
5. ***Electromagnetism*** (Brazil) – Physics for graduates.

Class	NQ of Students	Semester	Grade Distribution
General Physics Without Calculus	29	Feb-May, 72	10A.10B, 7C, 1D, 1F
General Physics With Calculus	12	Sept-Jan,71	5A, 6B, 1F
Modern Physics	17	Feb-May, 71	9A, 6B, 1C, 1D
Quantum Mechanics	5	Sept-Jan,71	4A, 1B
Electromagnetism (UFRJ)	12	Aug-Nov, 72	5A, 7B

Table 1 - Summary of information on the 5 courses.

Table 1 gives information on these 5 courses.

In the first two courses, the grades were obtained basically from:
Problem sets:
Laboratory reports;
Take home exam;
Final summary of the course or a final take home exam.

The take home exam did include essays or were totally essays. In particular, the fundamental points of an article in one of the scientific journals say *Scientific American* are summarized. These articles generally have a practical interest bearing on the topics under discussion and are within the scope of the students.

In the last three courses, the grades were obtained without including lab reports, since no lab work was done.

In the first four courses, the students were given the opportunity of suggesting their individual relative weightings for the different learning experientes. Table 2 shows this information for the Modern *Physics* class. It

	Learning Experiences			
Students Requests	Film Report	Homework Assignments	Class Project* Written	Class Project* Oral	Final Summary
Maximum Weighting (%)	40	90	35	20	30
Minimum Weighting (%)	10	10	10	1	15
Average (%)	22.12	25.37	21.12	12.21	19.17
Frequency of Learning Experiency, not entirely Students Requests	7	11	1	1	1

Table 2 - Information on students' requests on the relative weighting of their learning experiences for calculating grades in *Modern Physics* course. This table is extracted from the paper *A Study in Student-Teacher Grading Interaction Process, by M. I.* Pratt and T. A. E. C. Pratt.* Class project was required of every student and it was to report on a topic in class and submit a paper on it.

should be said that the general idea is to vary the learning experiences in the class, taking into account the different talents of the students, as an approach to maximize the learning process for each student.

In all cases, opportunity was also given to the student to do an additional special project related to the course and considered acceptable quality in order to maximize his chances of passing the course.

b) Brazilian Situation

In the fifth class, under totally new situation for the professor and I dare to say for the students too, in an environment totally oriented to exams, the situation was handled with extreme caution. The professor had been warned by other professors that Brazilian students copy a lot and therefore a no "in class exam policy" was totally ridiculous. However, the students were then asked by the professor to vote on an "in class exam policy". The choice was unanimous: no in class exam. At this time, the students were told that their grades would be obtained from problem sets and a summary of the course at the end of the semester, each weighted equally to produce the final grade. It was also emphasized that discussion amongst students was permitted but at no time should there be any copying of solutions from one student by another. Further, no late solutions would be received after a class discussion of the previously graded assignment which was generally the next lesson after the due date.

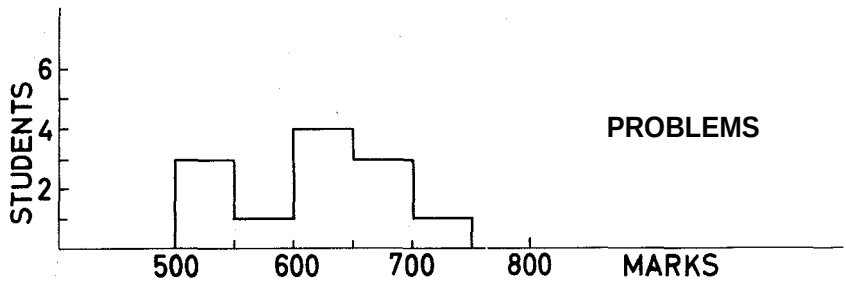

Figure 1 - Histogram of the marks gained by the Brazilian class during the Semester from problem sets only.

There were eight sets of problems covering 20 problems with a total mark of 1000 to be gained. Figures 1, 2 and 3 give some information on the distribution of marks gained in the class. This information is also found in table 3. From the table we see that the marks in the problem sets range from 501 to 724 and in the Summary from 500-900 producing finally a range from 55.4 to 81.2%.

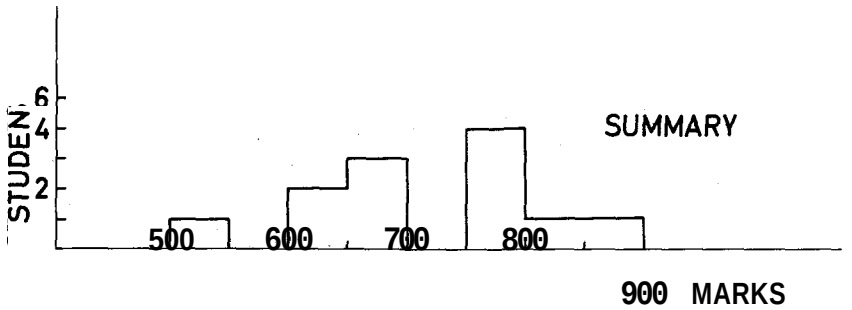

Figure 2 - Histogram of the marks gained by the Brazilian class on the final assignment of summarising the material learnt during the Semester in the Course.

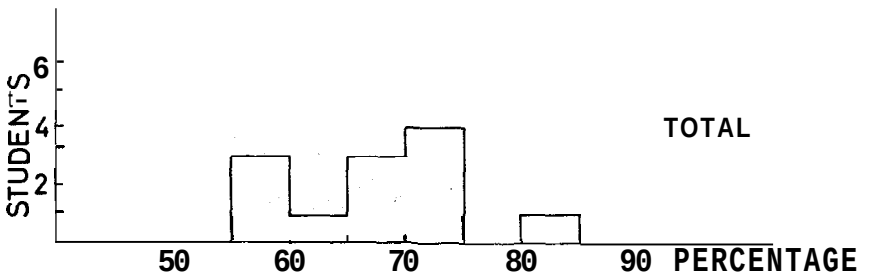

Figure 3 - Histogram of the total percentages – Problems and Summary-gained by the Brazilian class for the whole Semester

Problem sets (1000)	Course Summary (1000)	Total Marks (2000)	Total % (100)
514	650	1164	58.2
593	700	1293	64.7
682	800	1482	74.1
501	850	1351	67.6
724	900	1624	81.2
650	800	1450	72.5
537	650	1187	59.4
662	800	1462	73.1
639	700	1339	67.0
607	500	1107	55.4
637	700	1337	66.9
673	800	1473	73.7

Table 3 - Information on the distribution scores in *Electromagnetism* (1972).

3. Discussion Using Brazilian Students' Comments

In Table 1 we see that the five classes have a grade distribution which is not dissimilar. Total comparison of this process with the "in class exam" type in terms of learning is very difiicult since comparison ought to be done with the same group, same course two ways.

An attempt made is to get some feel for various aspects of the problem by means of students questionnaires. These were administered on the last day of the class with the understanding that the students grades will not be affected by their comments and that their grades were awarded at the end of that period.

1. Four answers are presented to this question – *Do you think that "in class" exams would have enabled you to learn more in E-M IV this semester?*

a) Creio que o melhor método foi o empregado pelo senhor, uma vez que com esses exercícios pudemos aprender muito mais e também com mais tempo para desenvolver melhor os tópicos dados. As provas em aulas têm um prazofixo, o que nos leva a cometer êrros infantis e de nada adiantam, pois medem só relativamente o conhecimento de cada um.
b) Não creio que a existência de provas tivesse ajudado mais, pois o estudo que fazemos para a prova não é tão hem orientado quanto no caso em que existem nrohlemas.
c) Creio que não. O curso da maneira que joi dado deu mais chance para que eu tivesse aprendido uma grande parte da matéria ao passo que em prova. poderia ter aprendido ou não pois particularmente entendo que prova não mede conhecimento, ainda mau em curso de Pós-Graduação.
d) Não, pois eu pelo menosfico muito nervosa em hora de prova e muitas vezes não consigo demonstrar tudo o que sei. Acho que prova num curso de Pós-Graduação é um absurdo pois não mede conhecimento algum e ainda mais aue um curso de Pós-Graduação ninguém o faz obrigado r sim porque deseja para melhorar os seus conhecimentos.

2. As compared to the situation where "in class exam" plays a large part in the assignment of the final grade, the question of students copying especially solutions of problem sets from eacli other is important. However it seems unlikely that many students will persistently copy all the time especially if the frequency of assignment is high. Further, copying in essay type assignments is easily detectable and therefore not too likely. On the other hand, the question is whether the learning process in a copying situation is zero. In most cases, the answer is no since this copying functions within the environment of the class discussion of the subject matter. Obviously, if one copys the wrong solutian then the leaming initially is zero.

However, a strong point can be made that the process that might allow copying also allows the professor the freedom to make difiicult assignments which could not be tackled in the hour of "in class exam".

In the questionnaire, the question was asked – ***Do vou know whether there was copying of problem solutions?***

It should be said that the general feeling from the responses is that there was discussion but not outright copying. Here is a student's answer:

Os problemas que cada um sabia fazer, procurava-se desenvolver cada um por si só e ao final discutir os resultados. Quase sempre nos reuníamos em grupo para debater aqueles problemas em que havia maior dificuldade. Todos discutíamos então sobre esses problemas e procuravamos chegar a uma solução satisfatória. Procurava-se compreender a solução de um problema quando feito por outro estudante, e não apenas copiá-lo. Muitas vezes pode não ter havido, por falta de tempo, uma melhor compreensão sobre um determinado exercício. Na maioria dos casos, todos procuravam entender, pois sentiam que estavam aprendendo alquma coisa com o curso.

3. This system forces most (if not all) of the students to work everyweek rather than at exam time. This alsq means that the professor is forced also to grade papers nearly everyweek rather that at "four exam periods". It would appear that the only gratification from the professor's point of view is that weekly learning over the semester is better than wholesale cramming at certain pressure periods.

4. Because of the work involved to the professor, this method is not geared to large classes, especially where objective "in class" exam could be used and tabulated by a machine. Of course, if the ernphasis is on learning, then the drawbacks of the objective exam would have to be considered. The problem of adapting the no "in class exam" policy to all teaching situations was explored from the student's point of view.

Three responses to the question – ***Do you think that the method of teaching in this course should be used always in all teaching situations?*** – are:

a) O processo foi muito bom, e como já disse anteriormente, considero os problemas propostos e a correção posterior pelo professor como a melhor maneira de me fazer estudar a teoria periodicamente (em relação as outras disciplinas).

b) Sim, sendo controlado pelo professor. Além disso, é necessário que o professor conheça bem os seus estudantes, porque muitas vezes alguns alunos, por questões circunstanciais, não conseguem refletir o que realmente são, em tão pequeno período de contacto com o mestre.

c) Sim, pois nos foram dadas em classe idéias para resolução de problemas posteriores. Acho que em um curso de graduação deveria ser utilizado o mesmo método, apenas haveria a necessidade de provas pois as turmas são muito grandes e não há a possibilidade de se conhecer bem todos os alunos

5. Some of the responses in the last section touched on another element – the student-teacher interaction. The student-teacher interaction is dominant in this system **A** high frequency of assignments would produce a high frequency of negotiations with regards to the dates of retum of the solutions. The problem centers on the demand for the professor to recognize the students lack of time. On the other hand, if the emphasis is on students learning, then the purpose is defeated if the students do not have time to do the work. This problem is even more accentuated because of the fact that some of the students in the post graduate program are your colleagues. This is borne out by the following comment to the statement on the questionnaire – ***You are at liberty to make any comment about the course if you wish:***

Eu creio que o curso tenha sido de bom nível E necessário porém que os professores tenham conhecimento da diferença entre os alunos, pois existem algumas diferenças entre eles. Por exemplo alguns estudantes são professores no Instituto e tem por isso, uma carga horária grande.. Outros não são professores no Instituto e portanto devem apresentar um aproveitamente melhor. É necessário levar este fato em conta

4. Conclusion

It could be said generally, for one reason or the other, that nobody wants an "in class exam". In connection with the Brazilian situation, it appears that students feel the importance and difference of being a post graduate. They require and demand treatment as such. Under these circumstances, "in class exams" do not make them feel respected and are not the best indicators of their real abilities.

SOCIEDADE BRASILEIRA DE FÍSICA

1. DIRETORIA (1971-1973)

Presidente - Alceu G. de Pinho Filho (PUC-GB)
Vice-presidente - Ernst Wolfgang Hamburger (USP)
Secretário Geral - Giorgio Moscati (USP)
Secretário - Carlos A. Dias (UFBa)
Tesoureiro - Olácio Dietzsch (USP)
Secr. p/Assuntos de Ensino - Beatriz Alvarenga (UFMG)
Secr. Adjunto p/Ass. de Ensino - Marco Antonio Moreira (UFRGS)

2. SECRETÁRIOS ESTADUAIS (1970-1972)

Rio Grande do Sul - Victoria E. Herscovitz (UFRGS)
São Paulo - Nelson Jesus Parada (UEC)
Minas Gerais - Francisco Cesar de Sá Barreto (UFMG)
Bahia - Sergio Cavalcanti Guerreiro (UFBa)
Pernambuco - Ivon Palmeira Fittipaldi (UFPe)
Ceara - Homero Lenz Cesar (UFCe)

3. CONSELHO

Jayme Tiomno (Princeton, EUA)
Ross Alan Douglas (USP)
Ramayana Gazzinelli (IPR)
José Leite Lopes (Strasbourg, França)
José Goldemberg (USP)
Shigueo Watanabe (USP)
Erasmo Madureira Ferreira (PUC-GB)
Jorge André Swieca (PUC-GB)
Cesare M. Lattes (UEC)
Francisco A. Germano (UFCe)

Suplentes

Luiz Carlos Gomes (UNB)
Henrique Fleming (USP)
Fernando de Souza Barros (UFRJ)
Rogério C. Cerqueira Leite (UEC)
Nelson Jesus Parada (UEC)

Endereços

PUC Instituto de Física
Pontifícia Universidade Católica
Rua Marquês de São Vicente, 209
20000 - Rio de Janeiro GB

USP Instituto de Física
Universidade de São Paulo
Caixa Postal 20516
01000 - São Paulo SP

UFBa Instituto de Física
Universidade Federal da Bahia
Federação
40000 - Salvador BA

UFMG Instituto de Ciências Exatas
Universidade Federal de Minas Gerais
30000 - Belo Horizonte MG

UFRGS Instituto de Física
Universidade Federal do Rio Grande do Sul
Av. Luiz Englert s/n
90000 - Porto Alegre RS

UEC Instituto de Física
Universidade Estadual de Campinas
Cidade Universitária
13100 - Campinas SP

UFCe Instituto de Física
Universidade Federal do Ceara
Caixa Postal 1262
60000 - Fortaleza CE

IPR Instituto de Pesquisas Radioativas
Universidade Federal de Minas Gerais
Caixa Postal 1941
30000 - Belo Horizonte MG

UNB Departamento de Física
Universidade Nacional de Brasília
70000 - Brasília DF

UFRJ Instituto de Física
Universidade Federal do Rio de Janeiro
Ilha do Fundão
20000 - Rio de Janeiro GB

UFPe Instituto de Física
Universidade Federal de Pernambuco
50000 - Recife PE

ESTA OBRA FOI COMPOSTA EM TIMES ROMAN
PELO SISTEMA DE FOTO COMPOSIÇÃO (*Monophoto*) E IMPRESSA EM *Off-Set* PELA
DISTRIBUIDORA PAULISTA DE JORNAIS
REVISTAS, LIVROS E IMPRESSOS LTDA.
RODOVIA PRESIDENTE DUTRA, KM 396
GUARULHOS — ESTADO DE SÃO PAULO