PEER INSTRUCTION AND GROUP ASSESSMENT IN ALGEBRA CLASSES

Eduarda Pinto Ferreira

ISEP – Polytechnic Institute of Engineering of Porto, GECAD – Knowledge Engineering and Decision Support Research Center

Gabriela Gonçalves, Marisa Oliveira, Marta Pinto Ferreira

ISEP – Polytechnic Institute of Engineering of Porto

ABSTRACT

The present work shows us the results obtained in a case study, whose main objectives were to evaluate the receptivity of students regarding the Peer Instruction (PI) method and make a comparison with the traditional one. This comparison was performed in the following way: firstly, in two consecutive years (2011/2012, 2012/2013) using two tests during the semester; secondly, with a Group-Assessment (50% of practical classes) +Two tests during the semester (2013/2014). The study was conducted with 387 students of the first year of an Algebra course of Informatics Engineer.

KEYWORDS

Peer-Instruction, Group-Assessment, teaching-learning process, learning strategies
Standards: 7, 8, 11

INTRODUCTION

First of all we can begin by pointing out that teaching an Algebra course to freshman students is not a very easy and appellative task nowadays.

Within the main challenges that teachers face, there is an important one – the lack of motivation on behalf of students to learn the contents. This is mainly a result of the way the program is organized and the information is transmitted to them.

The traditional lecture is nearly always delivered as a monologue to a passive audience, thus leading to a serious problem. Only exceptional lecturers are capable of holding students' attention for an entire lecture period. It is even more difficult to provide equal opportunity for students to critically think through the arguments being developed. They are built with just one purpose: focus their attention on the professor. The professor is active, and the audience is just sitting there, supposedly taking in information.

In practical classes, students are presented a set of exercises and their task is to solve them, while the teacher's role is to act as a tutor.

Nevertheless, many students just sit passively waiting for the teacher or other colleagues to solve the problems.

The scenario described above is not very engaging for either parties. In order to create a more interesting one and increase productivity in order to establish a hard-working environment, this year peer-instruction and group-assessment were introduced in an Algebra course with about 400 students.

As a way to improve this point, both the school and teachers should make an effort to introduce new methods and not be afraid to do so. One of the methods is PI.

Peer-instruction was used in lectures, while group-assessment was used in practical classes. Regarding the last ones, classrooms are set up like in elementary school, four or five students per table, facing each other, and solve a set of exercises as a team. Each week, one of the sets is delivered for assessment.

The classes took a lively turn, quite uncommon in math classes, and the student feedback has been quite positive. Both qualitative and quantitative results will be provided in the paper. Second, the course has 5 ECTS, it´s a discipline of the 1st year, 1st semester of the course of Informatics Engineer of the ISEP – Polytechnic Institute of Engineering of Porto (School of Engineering).

Since they are 1st year students, the PI leads them towards a path that enables them to become aware of the CDIO theory. It's their first contact with the program and its concepts, so they will slowly reach the desired objective.

Finally, the structure of the paper is as follows: Section II describes Peer Instruction and Group-Assessment, Section III, presents the used techniques and in Section IV we explain the assessment results.

PEER INSTRUCTION AND GROUP ASSESSMENT METHOD

Peer Instruction, (Standards: 7, 8)

Peer instruction (PI) was developed in the 1990's at Harvard University by Eric Mazur and has become a successful interactive teaching method in physics (Crouch, 2007) (Mazur, 1997). PI is gaining popularity in calculus classrooms but there is limited documentation about its effectiveness (Pilzer, 2001) (Miller, 2006).

In this method:

- The teacher presents students with a qualitative (usually multiple choice) question that is carefully constructed to engage student difficulties with fundamental concepts;
- The students consider the problem on their own and contribute their answers in a way that the fraction of the class giving each answer can be determined and reported;
- Students then discuss the issue with their neighbours for two minutes and vote again;
- The issues are resolved with a class discussion and clarifications.

This method, besides having the advantage of engaging the student and making the lecture more interesting to them, has the tremendous importance of giving the instructor significant feedback about where the class is and what it knows.

Too often, we use the "union of knowledge principle" -- if any student in the class knows something, we assume the whole class knows it. The response system gives us much better information about the distribution of knowledge among our students. This method also offers significant increase in opportunity for students to engage in discussions of reasoning and epistemology (how we decide which answers are right and under what circumstances the answers hold).

Group assessment (Standard 11)

In this method:

- The teacher presents students with a qualitative (usually multiple choice) question that is carefully constructed to engage student difficulties with fundamental concepts;
- Students discuss the issue with their neighbours during some minute, 5-10 min per issue;
- The student gives the answers for assessment;
- The teacher offers a solution to students.

This method, like peer instruction, also has the advantage of engaging the student and making the lecture more interesting. It has the tremendous importance of giving the instructor significant feedback about the knowledge acquired in each issue in every class, and what are their particular problems since the behaviour is very different and the approach has to be made in different ways.

TECHNIQUES

Peer Instruction

Data sources included classroom data show, a white board and “fingers” (no clickers).

There were 387 students enrolled in 5 small sections of 50 minutes with 70 to 80 students.

These small sections were taught by 4 different lecturers.

As a large number of our students are working students and do not have much time to study at home, this obliges the lecture to spend, at least, in the beginning of each class, about 25 minutes, doing an extensive summary of the subject.

Then, after spending these 25 minutes with PI method he continues the class presenting them with some multiple-choice questions. The lecturer gives them a few minutes so that the student can provide an answer. The students think by themselves and register their vote. After this, the lecturer asks the students to discuss the issue with their neighbours, preferably a student who gave a different answer.

If the lecture put the following question, Figure 1:

Which of the following set are vector spaces?

1. $A = \{(x, y) \in \mathbb{R}^2 : 2x + y = 0\}$;
2. $B = \{(x, y) \in \mathbb{R}^2 : xy = 0\}$;
3. $C = \{(x, y, z, w) \in \mathbb{R}^4 : x + y + z + w = 2\}$

Answer:

a) A, B, C are vector spaces.
b) Only B, C are vector spaces
c) Only A is a vector space
d) None of them are vector spaces
e) None of the above

Figure 1. Example of a question

Some of the questions the students make to their neighbours are:

"What did you answer? ", "Why?" Students share their reasoning and their math knowledge for four or five minutes and vote again.

With the question we present to students we assess whether the students have learned the lecture objectives.

Group assessment

There were 387 students enrolled in 10 small sections of 80 minutes with 35 to 40 students, twice a week. These small sections were taught by 4 different lecturers.

Like in the Peer Instruction in the Group assessment classes, having many working students enrolled, obliges the lecturer to practice the same of class as in Peer Instruction, divides in 65 minutes in the beginning of the class, where the students are encouraged to solve some exercises in small groups, or by themselves. Should any problem arise they have the teacher, playing the role of tutor. In the last 15 minutes, in some classes, they have some group assessment exercises.

ASSESSMENT RESULTS

Assessment Results

The following table, Table 1, presents the assessment activities on Algebra course at ISEP.

Table 1. Assessment Subjects

Year	Assessment Subjects
2011/12	Two test during semester
2012/13	Two test during semester
2013/14	Group assessment (50% of practical classes) + Two test during semester

The Table 2 shows the development of the results of the last 3 years, in Algebra.

Table 2. Resume of all results*

	2011-12	2012-13	2013-14
Success	43%	56%	68%
Fail	57%	44%	32%

* all students were evaluate

The following Table 3, 4 and Figure 2 show that most of the students have better results with significant improvement of classification.

Table 3. Students who succeed

Succeed		20	19	18	17	16	15	14	13	12	11	10	Total
2011-12	Re-enrolment	0	1	0	0	1	1	1	2	4	4	8	**22**
	New	1	0	2	3	6	12	10	10	10	16	20	**90**
	Total	**1**	**1**	**2**	**3**	**7**	**13**	**11**	**12**	**14**	**20**	**28**	**112**
2012-13	Re-enrolment	0	2	1	0	1	3	6	4	5	5	18	**45**
	New	2	3	2	4	9	13	19	17	22	15	18	**124**
	Total	**2**	**5**	**3**	**4**	**10**	**16**	**25**	**21**	**27**	**20**	**36**	**169**
2013-14	Re- enrolment	0	0	0	0	4	3	3	5	4	6	22	**47**
	New	0	4	2	16	11	18	25	23	28	24	22	**173**
	Total	**0**	**44**	**2**	**16**	**15**	**21**	**28**	**28**	**32**	**30**	**44**	**220**

Table 4. Students who failed

Failed		9	8	7	6	5	4	3	2	1	0	Total
2011-12	Re-enrolment	5	8	9	3	8	9	4	2	4	0	**52**
	New	4	22	10	9	14	13	10	5	10	0	**97**
	Total	**9**	**30**	**19**	**12**	**22**	**22**	**14**	**7**	**14**	**0**	**149**
2012-13	Re-enrolment	5	6	6	11	11	6	9	4	6	2	**66**
	New	9	8	12	8	7	5	9	6	3	2	**69**
	Total	**14**	**14**	**18**	**19**	**18**	**11**	**18**	**10**	**9**	**4**	**135**
2013-14	Re- enrolment	11	13	10	10	6	4	2	2	1	0	**59**
	New	11	14	6	3	6	2	1	0	0	2	**45**
	Total	**22**	**27**	**16**	**13**	**12**	**6**	**3**	**2**	**1**	**2**	**104**

The results show that, unlike in the past two years, students have shown interest in the classes. Furthermore, comparing results with those of last year (Tables 3 and 4), there has been an overall dramatic improvement.

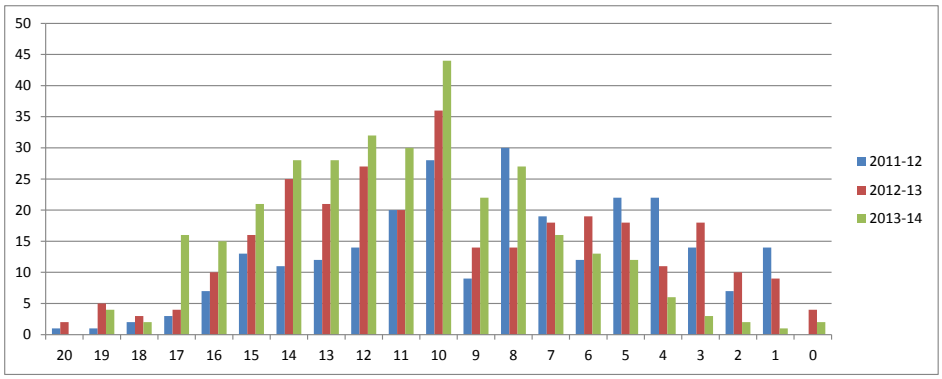

Figure 2. Results

Survey

At the end of the semester we offered an online survey to the students. Tables 5 and 6 show the data collected from the 60% of students who answered.

Table 5. Group assessment survey

Learn more with this assessment	Don't learn more with this assessment	Doesn't matter, learn anyway	More group assessment with less topics	Less group assessment with more topics
90,5%	4,8%	0%	4,8%	0%

With this survey, we conclude that the students definitely think they learn more with group assessment.

Table 6. Peer instruction survey

It made the lessons more interesting	Learn more in this type of classes	Don't learn more in this type of classes	Doesn't matter, I always learn	Doesn't matter, I didn't learn anyway
90,5%	4,8%	0%	4,8%	0%

With this survey, we conclude that the students definitely believe they learn more with peer instruction lessons.

CONCLUSION

The results show that, unlike last year, students have demonstrated interest in classes and the overall results have dramatically improved with these methods. Furthermore, the new student segment achieved the most noticeable improvement in results.

We will apply these methods again next year, possibly extending them to other courses in order to reinforce our conclusions.

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BIOGRAPHICAL INFORMATION

Eduarda Pinto Ferreira, is a lectures of Mathematic at ISEP - Instituto Superior de Engenharia do Porto, Portugal. PhD in Science Engineering. Chairman of 1st CDIO Iberian Workshop (ISEP), March 2011. Chairman of the 3rd ESICUP Meeting (EURO Special Interest Group on Cutting and Packing), international conference in Porto (ISEP), March 2006. Member of the Scientific Committee of JBLE-09 (Jornadas Luso-brasileiras de Engenharia), Porto (ISEP), February 2009. Attend all CDIO conferences since 2008. President of Pedagogical Council since January 2010.

Gabriela Gonçalves, Msc, is a lectures of Mathematic at ISEP - Instituto Superior de Engenharia do Porto, Portugal.

Marisa Oliveira, PhD, is a lectures of Mathematic at ISEP - Instituto Superior de Engenharia do Porto, Portugal.

Marta Pinto Ferreira, Msc, is a lectures of Mathematic at ISEP - Instituto Superior de Engenharia do Porto, Portugal.

Corresponding author
Prof. Eduarda Pinto Ferreira
Departamento de Matemática
Instituto Superior de Engenharia do Porto
Rua Dr António Bernardino de Almeida, 431
4200-072 Porto, Portugal.
+351 96 339 35 18
epf@isep.ipp.pt
eduardapf@gmail.com
Skype name: eduardapf

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