Importing Cooperative Pedagogy into Postgraduate Courses – an Experiment

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Abstract

This article presents and analyses a pedagogical experiment carried out at Polytech Marseille Engineering School (Aix-Marseille University). The key idea is to directly integrate cooperative pedagogy into the system as is, in order to tackle three challenges: 1) transform the problem of inhomogeneity of students into a strength through cooperation, 2) strengthen the capacity of students to share, understand, listen, communicate and hence, develop their faculty to work in a group, 3) develop their autonomy.

Actually, the co-authors of the paper belong to the group of students who were part of the experiment. The intention of the principal investigator (PI) is also to lead students to become actors of their own training.

For the present experiment, the PI integrated cooperative pedagogy into a "classical" four months L3 Algebra course. The approach was based on Conway and al. 93 [2] and Grajczonek 2010 [4], that is: on the one hand group work with peer evaluation has been used both to prepare tutorial classes and solve a weekly "challenge exercise"; on the other hand, a php/mysql application has been developed and released for individual weekly testing.

More precisely, the objective was to integrate cooperative work right into the ECTS system. Therefore, importing as such classical approaches of cooperative pedagogy was impossible; work had to comply with the program and schedule of the engineering school.

Groups of five to six students have been defined according to their curriculum in order to create groups of "similar inhomogeneity" (some of the students were hardly more than beginners in Algebra, other already had a Licence 2 in Mathematics). Group work was structured with four roles (secretary, moderator, facilitator, redactor – attributed weekly) and weekly evaluation was done through the group challenge exercise, the secretary report and peer evaluation of students (using the WebPA application developed by Loughborough University, UK).

Also in order to evaluate students weekly on an individual basis, the PI developed some years ago a random test generation application (php/mysql). This application has been extended and released as a freeware by the co-authors.

Similarly, co-author students have conducted the evaluation of the approach presented in this paper.

1. Introduction

Whereas standardization keeps improving in postgraduate curricula (through the ECTS system, international exchange structures such as Eiffel, etc.…), thus creating bridges between trainings or even countries, the heterogeneity of students increases accordingly. This issue concerns particularly scientific trainings; for instance, the Mathematical foundations expected as prerequisite, differ widely from one country to another as well as from one specialization to another.

Unfortunately, such heterogeneity gives rise to inhomogeneity rather than to exchanges. The current trend in student populations, encouraged by commonly agreed reference values such as efficiency, concurrency or personal achievement, is not to develop cooperation and knowledge sharing. And in spite of the development of virtual links through media such as social networks, cooperation and knowledge sharing (which are different from e-learning as they entail bilateral relations) fail to develop through these new communication media (maybe because they are time and empathy consuming). Quite the contrary, we can only note the expansion of individualism and isolation among students.

Therefore, like in Johnston & Miles, 2004 [6] or Cheng & Warren, 2000 [1], our intention was to simultaneously: 1) improve teaching efficiency, 2) transform heterogeneity of levels into a wealth, 3) get studends to develop autonomy, collaboration and communication skills and hence empathy, capacity to share and help one another, as well as their ability to evaluate their peers and receive such feedback.

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However, the afore mentionned approaches are based on a revision of the educative system itself: Universities or at least trainings adopt a cooperative approach. In our context, the intention was to integrate group work into a french classical Engineering training as such.
Therefore, we decided to introduce group work in parallel to tutorial classes. As pointed out by most previous works, a proper balance between individual evaluation and group work and evaluation is essential (to ensure group dynamics and avoid "free-riders"). Previous works such as Cheng & Warren, 2000 [1] or Grajczonek, 2009 [5] have shown that peer evaluation can help to ensure this balance. Different peer evaluation schemes have been proposed and assessed (see for instance Conway, Kember, Sivan, & Wu, 1993 [2], Gatfield, 1999 [3] or Grajczonek, 2009 [5]).
Our approach is inspired by Grajczonek and evaluation is performed both on an individual basis (weekly tests) and on a peer evaluation ponderation of group results.
In section 2 we present the context of the experiment, in section 3 we describe more precisely the organization of the training and evaluation. Section 4 analyzes the outcomes of the approach and we conclude in section 5 on the approach and perspectives.

2. Context

The present experiment has been carried our in Polytech Marseille Engineering School (Aix-Marseille University, France) in the computer science – license 3 cycle. It involved 57 students through a four months Algebra course.
Let us point out that license 3 is actually equivalent to first year in French engineering schools (which is a specificity of the French educational system). Polytech Marseille is actually an Engineering school belonging to Aix-Marseille University and as such, students have followed various initial trainings (license 2, preparatory classes, technical degree (DUT in France)), or they have been recruited from foreign trainings.
The course included 24 hours of lectures and 24 hours tutorial classes whereas the syllabus included both license 1 and 2 upgrading of skills in theoretical Algebra as well as license 3 proper notions (specific to the Computer Science training).
Teaching such a heavy syllabus within only 48 hours underlines the importance of cooperation and self-learning.

3. Description

3.1 General setting

Cooperation has been integrated into the curriculum in the spirit of Grajczonek, but the challenge was to insert cooperation into a "classical" engineering training.
The approach is synthesized in figure 1 and described with more details in next subsections.

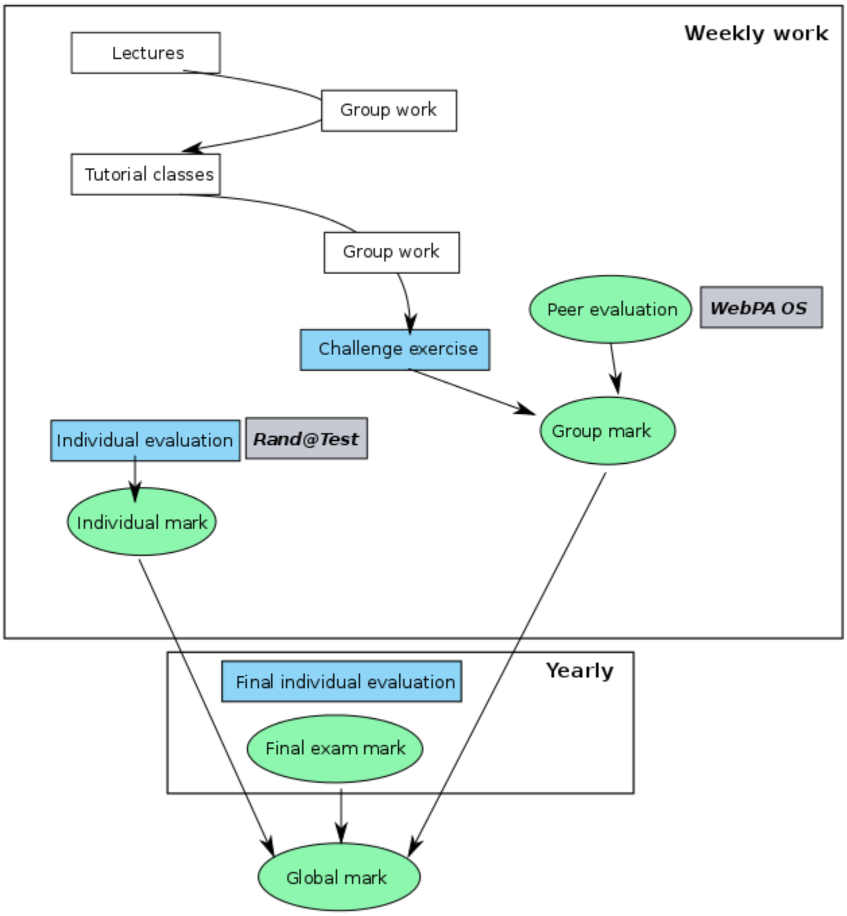

Fig. 1 – Synthesis of the approach

3.2 Group work

As underlined by previous works, the efficiency of cooperative pedagogy depends on the proper balance between group work / group evaluation and individual evaluation (cognitive sciences also underlined the importance of evaluation in the learning process). Other challenges were first to create group dynamics whereas the structure of classes was still a classical the lectures/tutorial organization, and second to improve students' self-evaluation skills (which is known to improve their concentration and involvement as well).
In order to ensure the homogeneous heterogeneity of teams, groups of five to six students have been created (it was actually impossible to create smaller homogeneous groups).
Group work has been developed on a weekly basis:

1. First group work (see fig. 1): prepare tutorials. Actually, tutorial exercises included both exercises labelled "fundamental" (providing an assimilation basis – this set of exercises was explored through group work and detailed further during tutorial classes); and exercises labelled "training" (for personal further work).
2. Second group work (see fig. 1): solve in a cooperative way a "challenge" exercise and write a detailed answer (used for weekly group evaluation). The level of this exercise was clearly higher than tutorial exercises to stimulate interaction and research in the groups.

Self-organization of groups was ensured through four roles (reassigned each week): facilitator (who was in charge of the organization of the group meetings), secretary (who wrote a weekly report on the group activity: schedule, problems, impressions…), moderator (who invited the member of the groups to either participate more or listen to the others) and writer (who was in charge of writing the final solution for the "challenge" exercise).

3.3 Evaluation – goals and means

As shown by state of art studies, evaluation plays a key role in cooperative pedagogy. Strangely enough, while the approach intends to help students to consider marks and evaluation as a tool rather

than a goal, it uses this erroneous belief itself as an engine. Actually, the greed for marks is strong enough to help and start the group dynamics. Because they known they will share a group mark, students start standing together.
However, as shown by Conway and al., pure group evaluation is not sufficient:

- Weighting group marks by a peer evaluation process stimulates individuals inside the groups.
- Individual evaluation is necessary both in order to stimulate individuals and to facilitate knowledge acquisition.

Peer evaluation (and further weighting of group marks by peer evaluation coefficients) was performed at the end of each week using the Web application WebPA OS (developed by Loughborough University, UK). More precisely, students were invited to evaluate their peers on four criteria: 1) technical contribution, 2) organizational contribution, 3) contribution in raising questions and exchanging, 4) cooperative contribution (involvement in the group, capacity to share, give and listen to the others). Hence, whatever the technical level of students, all of them had the opportunity to bring their own skills to the group.
Each criterion was rated between 0 and 3 and a global weighting coefficient was obtained with WebPA algorithm and applied to the group mark to obtain an individual group mark.
The last issue relates to weekly individual evaluation. It was out of question ensuring formal examination condition each week, as well as giving the same test to 57 students sitting side by side. Hence the PI developed the Rand@Test PHP Web application. Starting from a database containing both the identity of students and a set of equivalent questions, the application generates randomly nominative tests (hence minimizing the probability for two neighboring students to receive the same test). This application is now available for download at http://alexandra.bac.perso.esil.univmed.fr/Applis/RandAtTest).

4. Results analysis

Average marks
Individual weekly assessment has been introduced three years ago. Figure 2 compares the distribution of marks (both final exam and individual weekly evaluation) over the three last years.

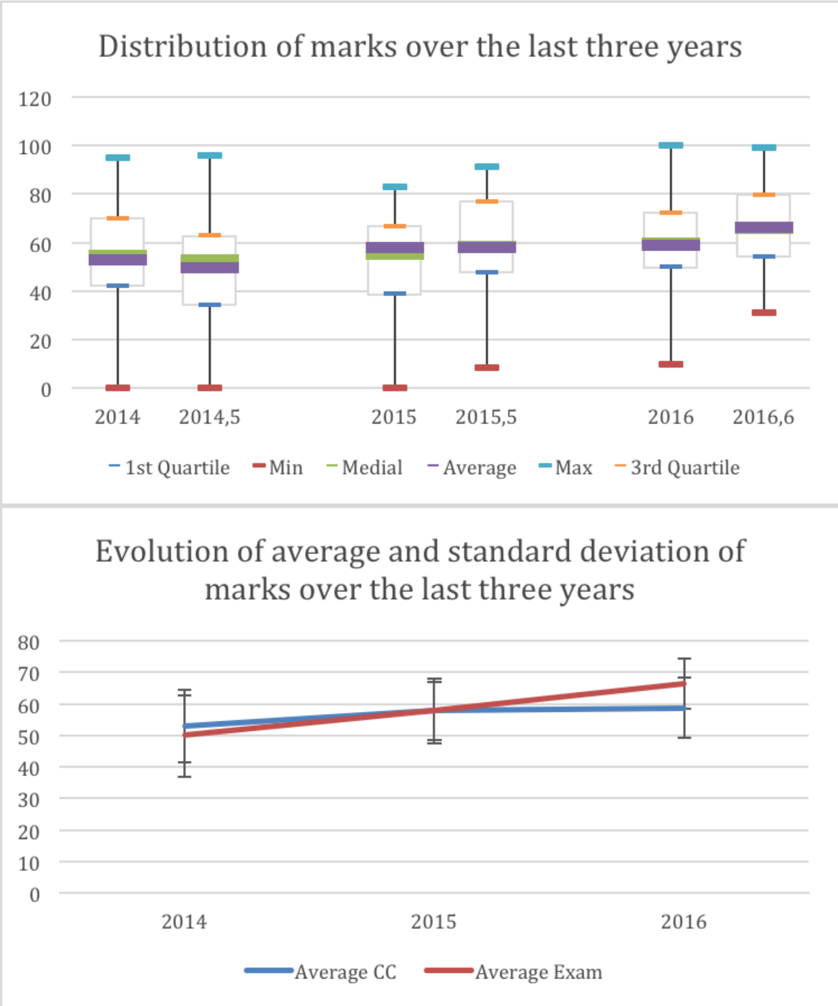

Fig. 2 – Statistics of marks (expressed over 100). Top: distribution of marks (for each year, left: weekly individual evaluations, right: final exam). Bottom: average marks.

The average final exam mark increased by one point with respect to both previous years. Also, although medial and third quartiles are roughly the same, the first quartile reached fifty out of hundred, that is academically average.

This first analysis suggests that team work has a perceptible impact on students marks (even if it wasn't possible to estimate the bias from available data). It seems that even if best and average students stay at the same level, weakest students tended to have better marks.

Continuous assessment and challenge exercise

According to previous analysis, one could expect a correlation between individual group marks and individual weekly evaluations. However, the average Pearson correlation is only 0,37, which suggests that these marks are actually not strongly related.

We can invoke several reasons:

1. At the end of the experiment, students were invited by the PI to return a written (and anonymous) synthesis. Several mentioned they encountered difficulties lowering evaluations of their peers. A larger scale (rate each criterion over 10) may help students to provide more accurate peer evaluations.
2. As a secondary effect of previous point, weakest students could rely on group "leaders", without much involvement in the group (even if they benefited from group work).
3. In order to create a healthy emulation inside groups, it has been shown that challenging objectives lead to a better dynamics (hence the “challenge” exercises). However, students reported that they needed more intermediate questions so that all of them could contribute.

Assessment mark and self-assessment

According to cognitive psychology works such as (Kruger & Dunning, 1999), skills improve the quality of self-assessment. Moreover, recent works in neuro-pedagogy showed that testing is almost as important in the learning process as lectures themselves. Therefore, students were asked at the end of the final exam to anonymously evaluate the mark they expected. We obtained a 0.83 correlation coefficient, which acknowledges this strong relationship.

5. Conclusion

In spite of its lack of maturity, the present experiment showed promising results, especially as it does not entail any adaptation of the training system. The combination of individual assessment, group assessment and peer evaluation created, as expected, an autonomous group dynamics and students results seem to have benefited from this system.

In order to move beyond the drawbacks described in section 4, the PI intends to explore different ideas. An accurate peer evaluation is essential; a better understanding of the approach and a larger range for peer evaluation criteria may help students to evaluate more precisely their peers. Moreover, even if challenging group works are necessary to stimulate cooperation, “challenge” exercises need to be progressive. The main issue is actually to lead students to work together, share their knowledge and involve in a common work.

In any cases, this initial experiment already shows the feasibility of the approach, that is, integrating some cooperation right into academic trainings without any prior modification of the system.

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