

ON GROUPING STUDENTS AND WORK TOPIC CHOICE IN COURSES OF LEARNING BY PROJECTS

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ABSTRACT

Two surveys were conducted among students in engineering courses where final work had to be delivered in the form of projects to ascertain their views regarding work group formation and topic choice.

One survey was carried out in two courses at the end of the first semester of the 2013-14 academic year (December 2013), and the other in three courses at the beginning of the second semester (February 2014). The results of the two courses in the first semester, as well as results of the three courses in the second semester, were averaged. As the number of respondents in the first and second semesters was similar, the results of the two surveys were also averaged to obtain global views on the two issues. This is discussed in the discussion section.

The opinions expressed by the students can be used as a good starting point to motivate them positively. In this way, they become more engaged in the work and more committed to learning.

The students were also consulted on their willingness to do (somehow rewarded) projects inspired by university research work or proposed by companies, for information purposes only. The results are mentioned at the end of the paper.

Keywords: Work groups, topics, motivation, projects, surveys

1 INTRODUCTION

Promoting positive student motivation engages students in their own learning will help them work with unnoticed effort and result in higher performance in learning course content. Content will focus on learning how to structure a project and develop an engineering design. Learning by projects in engineering design, involves different levels of accomplishment, i.e. project design and writing, project testing with modelling, or with a physical prototype.

To acquire knowledge, abilities and attitudes for project development, students are divided into work groups to discuss solutions and perform tasks. Several authors have analyzed various interesting aspects concerning of work groups [1-5]. In this paper, two important issues must be addressed before the start of the course to enhance student motivation: work group formation and project topic choice. Effective individual and group motivation significantly contributes to the accomplishment of learning objectives and, probably, production of good, original designs.


Although work group formation is generally previous to topic choice, both can occur simultaneously. Several combinations were tested over time. This paper describes the last one, which is as follows: group formation is based on friendship, and if necessary the group is completed with other classmates; as for topic choice, the group proposes several topics, the lecturer comments on them, and then the group chooses one. On some rare occasions, the group proposes several topics, and the lecturer recommends only one.

In the 2013-14 academic year, students enrolled in two compulsory courses were consulted in these two issues through an individual anonymous survey given at the end of the first semester to measure the degree of acceptance of the above combination. The courses were Engineering Projects within the Chemical Engineering [6] and Industrial Engineering [7] degrees.

A similar survey was conducted with students enrolled in three other courses on the first day of class of the second semester to capture their preferences. The courses were Engineering Projects within the Chemical Engineering degree [6]; Product Engineering and Technical Systems I [8]; and Creativity, Ecodesign and Patents [9] within the Industrial Engineering degree. In this case, after a rapid count of the survey results, the most voted combination was applied in the three courses.

2 METHODOLOGY

The surveys comprised two main blocks of questions about group formation and project topic choice. They were given to the students at the end of the first semester (December 2013) and at the beginning of the second semester (February 2014). The questions in the two surveys were essentially the same, but the in the latter case they were in compact form (Figure 1) and the main points were enumerated consecutively. Moreover, students were required to rank the first three options in order of preference for each block.

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ENQUESTA individual i anònima sobre: FORMACIÓ DE GRUPS I ELECCIÓ DEL TEMA DE TREBALL
ASSIGNATURA DE PROJECTES, ENGINYERIA QUÍMICA, (Q9, 5è curs), Curs 2013-14 Q2, 10/02/2014

La ensenyança per projectes en grups de treball és una metodologia que és mostra eficaç. Per això cal que es formi grups, i es defineixi un tema de treball. Els grups de treball més efectius solen ser d'entre 4 i 6, i donat el nombre usual d'estudiants d'una classe cal fer-ne 5 o 6 grups com a mínim.

Encercli la X de les tres opcions que més li atreuen, posant al costat el seu ordre de preferència, tant de la Formació de grups (I), com de l'Elecció del Tema de Treball (II).

I) FORMACIÓ DE GRUPS

a) No triar grup, i els grups es formen:

- 1-Per ordre alfabètic. X__
- 2-De manera aleatòria: proposats pel professor, per sorteig... X__

b) Triar treballar en un tema general proposat pel professor i a la vegada es forma el grup:

- 3-Apuntar-se individualment a un tema general que proposi el professor. X__
- 4-Apuntar-se amb un grup d'amics a un tema general que proposi el professor. X__

c) Fer els grups per coneixença o amistat (i després ja es triarà el tema):

- 5-Formació del grup per amistat i si és necessari es completa amb altres. X__
- 6-Formació del grup exclusivament per amistat. X__

II) ELECCIÓ DEL TEMA DE TREBALL

A l'assignatura de Projectes es proposen temes de treball sorgits en el grup o proposats pel professor, però podrien ser temes basats en la gestió que es fa a la UPC, o bé temes de treball per a una empresa industrial.

Normalment a l'assignatura de Projectes es fan treballs interessants de tipus innovador alguns d'ells són a més força creatius i podrien ser patentats, o publicats, o ser la base d'un Spin-Off. Probablement els temes de recerca de la UPC o proposats per la indústria podrien ser molt pragmàtics i concrets, pot ser no massa atractius, encara que podrien ser subvencionats econòmicament, i també podrien ser patentats o publicats.

-Senyali les seves preferències (i ordeni les tres millors) per a l'elecció del tema de treball:

a) D'assignatura

- 7-Li sigui assignat un tema al grup. X__
- 8-El grup tria un d'una llista preafixada de temes. X__
- 9-El grup proposa uns quants temes, i el professor en tria un. X__
- 10-El grup proposa uns quants temes, el professor els comenta i el grup en tria un. X__
- 11-El grup proposa i decideix el tema de treball. X__

b) De recerca en la UPC (no per empreses)

- 12-Li sigui assignat un tema al grup. X__
- 13-El grup tria un d'una llista preafixada de temes. X__

c) Proposat per una empresa industrial

- 14-Li sigui assignat un tema al grup. X__
- 15-El grup tria un d'una llista preafixada de temes. X__

Al darrs d'aquesta pàgina, pot comentar: i) Altres maneres de triar grup o tema. ii) Si el tema de treball fos per una recerca universitària o per una empresa quin tipus de compensació demanaria. iii) Altres observacions.

Moltes Gràcies per les seves opcions. Professor Dr. Joaquim Llovera Macià

Figure 1. Survey in compact form about group formation and topic choice at the beginning of the second semester for three courses

The following subsections are devoted to the several ways of creating work groups and selecting topics.

2.1 Ways of creating work groups

The first block consisted of three main options:

- a) No freedom of choice for students. Groups formed by choosing students
 - 1- By alphabetical order.
 - 2- Randomly: as proposed by the lecturer, by drawing lots...
- b) Groups are formed after students choose a topic from a list proposed by the lecturer. They can do it
 - 3- Individually.
 - 4- In groups of friends.
- c) Groups are formed based on friendship:
 - 5- If necessary, groups are completed with other classmates.
 - 6- Based on friendship exclusively.

2.2 Ways of selecting topics

The second block consisted of nine options. Students may or may not participate in the choice of topics. These can be inspired by student ideas or arise from the lecturer's own proposals, a university research work or a company's proposal.

- a) Topic inspired by students or lecturer:

- 1-A topic is assigned to the group.
 - 2-The group selects from a list of predefined topics.
 - 3-The group proposes several topics, and the lecturer chooses one.
 - 4-The group proposes several topics, the lecturer comments on them, and the group chooses one.
 - 5-The group proposes and chooses the topic.
- b) Topic from a UPC research work
- 6-A topic is assigned to the group.
 - 7-The group selects from a list of predefined topics.
- c) Topic proposed by a company
- 8-A topic is assigned to the group.
 - 9-The group selects from a list of predefined topics.

A note on the last page of the survey reads: On the back of this page, you can i) suggest other ways to choose group or topic; ii) specify the kind of compensation you would like to receive if the topic proposal came from a UPC research work or from a company, and iii) make other observations. The results of the surveys are show in the next section.

3 RESULTS

The number of collected surveys per class was:

- At the end of the first semester: Engineering Projects (Industrial Engineering degree (IND)) 25, which accounts for 83,3% of the class; Engineering Projects (Chemical Engineering degree (CH)) 34, which accounts for 91,9% of the class.
- At the beginning of the second semester: Engineering Projects (Chemical Engineering degree (CH)) 19, i.e. 76% of the class; Product Engineering and Technical Systems I (P.EN) 17, i.e. 50% of the class; Creativity, Ecodesign and Patents (CEP) 19, i.e. 79,2% of the class.
- In the survey conducted at the beginning of the second semester (where the students' first three choices were ranked in order of preference), the weight associated with the first preference was 3 points, with the second 2 points and with the third 1 point.
- The final values for each question are expressed in percentages (Table 1) for the two courses at the end of the first semester and the three courses at the start of the second semester, with averages (Av.) for one and both semesters.

Table 1. Percentage results for options for group formation of the 2013-14 academic year courses

I) FORMATION OF GROUPS	End 1st Semester			Beginning 2nd Semester			
	CH.	IND	Av.	CH.	P.EN	CEP	Av
1-By alphabetical order.	0	4	2	7,1	1	2,7	3,6
2- Randomly: as proposed by the lecturer, by drawing lots...	5,88	20	12,9	4,4	6,3	13,5	8,1
3- Individual selection of a topic from a list.	7,82	18,6	13,2	3,5	8,3	22,5	11,4
4- Group of friends' selection of a topic from a list.	31,85	1,3	16,6	38,1	27,1	21,6	28,9
5- Group formation based on friendship, and if necessary completion with other classmates.	53,41	54,6	54	32,7	38,5	36	35,7
6- Group formation based on friendship exclusively.	1	1,3	1,2	14,2	18,8	3,6	12,2

These values are shown in graphic form in figure 2. The number of surveys collected at the end of the first semester and beginning of the second semester was similar, 59 and 55, respectively.

Option 5, namely group formation based on friendship, and if necessary completion with other classmates, was the best rated one in the group formation block, followed by option 4, namely group of friends' selection of a topic from a list, with half the points.

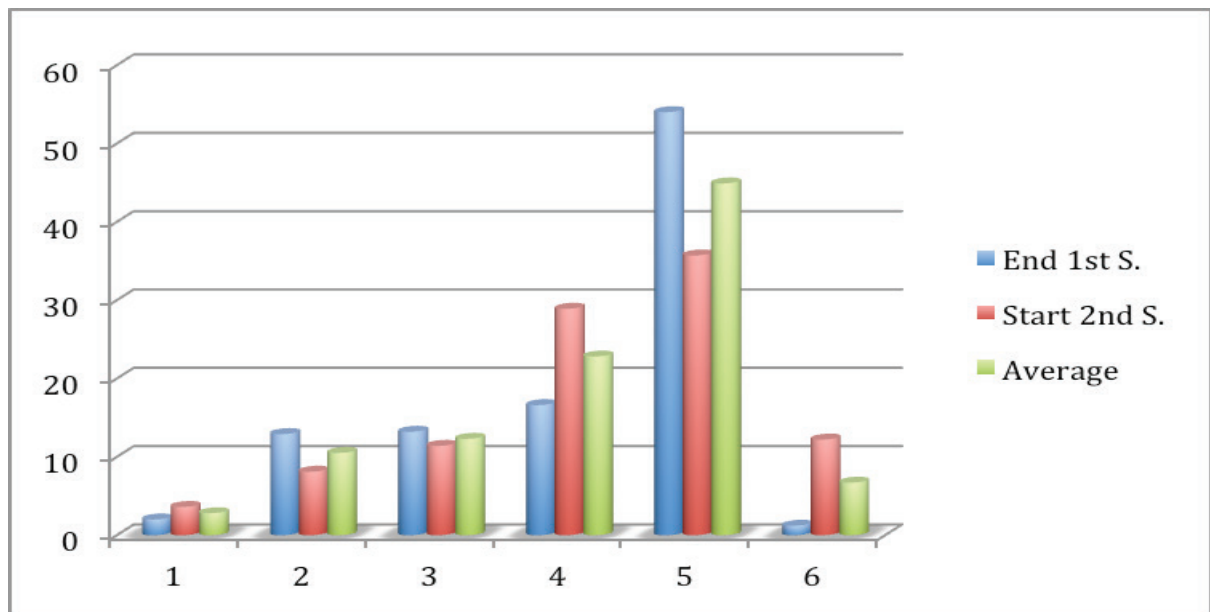


Figure 2. Results of 6 questions about group formation (values in percentage). Left column: survey at the end of 1st semester. Central column: at the beginning of 2nd semester. Right column: average

The second block was formed by options for topic choice, with results shown in table 2. The values are similar for the two courses of the first semester; however, there is some dispersion in the answers given by respondents at the beginning of the second semester. On the other hand, the averages between semesters are comparable.

Table 2. Percentage results for options for topic choice of the 2013-14 academic year courses

II) ELECTION OF TOPIC OF WORK	End 1st Semester			Beginning 2nd Semester			
	CH.	IND	Av.	CH.	P.EN	CEP	Av.
1-A topic is assigned to the group	0	1,9	1	5,3	2,1	0	2,5
2-The group selects from a list of predefined topics	12,4	7,5	10	27,2	17,7	7,9	17,6
3-The group proposes several topics, and the lecturer chooses one	5,7	9,4	7,6	4,4	13,5	4,4	7,4
4-The group proposes several topics, the lecturer comments on them and the group chooses one	17,5	18,9	18,2	5,3	22,9	21,9	16,7
5- The group proposes several topics and chooses one	6,8	3,8	5,3	4,4	2,1	1,8	2,8
6- A topic from a UPC research work is assigned to the group	0	1,9	1	2,6	1	1,8	1,8
7- The group selects from a list of predefined topics from UPC research works	26	24,5	25,2	19,3	17,7	25,4	20,8
8- A topic proposed by a company is assigned to the group	5,1	9,4	7,2	5,3	0	0	1,8
9- The group selects from a list of predefined topics proposed by companies	26,6	22,6	24,6	26,3	22,9	36,8	28,7

The figure 3 shows these average results.

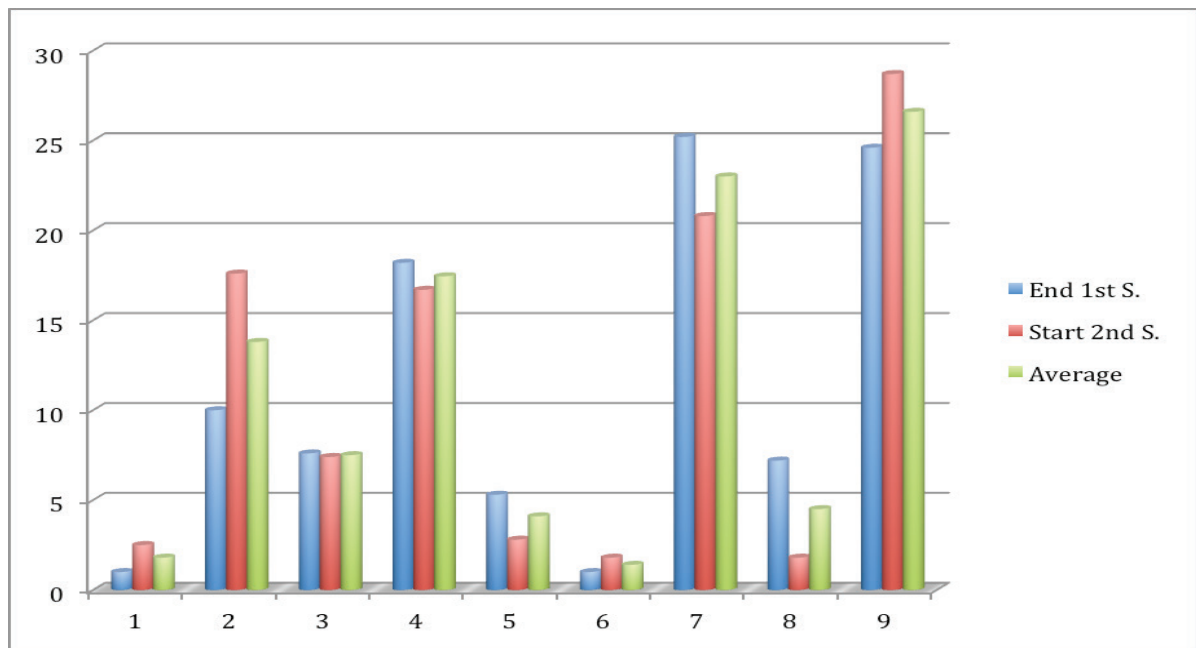


Figure 3. Results for 6 options for topic choice (values in percentage). Left column: survey at the end of 1st semester. Central column: survey at the beginning of 2nd semester. Right column: average

The best rated options are:

- 9: The group selects from a list of predefined topics proposed by companies (28.7%).
- 7: The group selects from a list of predefined topics from UPC research works (20.8%).
- 4: The group proposes several topics, the lecturer comments on them and the group chooses one (16.7%).

The results reveal a special interest in topics coming from UPC research works or proposed by companies. Unfortunately, these options are hypothetical because there is not organization to realize that, and the students' course works are not related to university research and companies' proposal. Notwithstanding, the lecturer was interested in knowing the students' opinions on this matter. Several papers deal with the analysis of the working relationship between industry and the university [10-11] in other countries.

Among the most voted, option 4 is the only possible one, and the results obtained at the end of the first semester confirm the preference for this option. However, option 2 was slightly more voted at the start of the second semester, especially in Engineering Projects (Chemical Engineering Degree (CH)). Therefore, this option was applied in this course.

Regarding the results for the open questions at the end of the page, it is observed that the question "If the topic came from a university research work or was proposed by a company, what kind of compensation would you like to receive?" was answered by few students; thus it is not very representative. However, a global trend in the answers to the three main questions is noteworthy: Would you accept without asking for anything in return? (with very few affirmative answers); Would you ask for your name to appear in a publication or a patent? (with nearly half the answers); Would you ask for an economic compensation? (with half the answers). Specifically, the interest in receiving an economic compensation is greater if the topic were proposed by a company.

4 DISCUSSION AND CONCLUSIONS

Several combinations of solutions for group formation and work topic choice were used in the courses. At the end of the first semester, the total number of collected surveys was 59, which accounts for 87.6% of students, whereas at the beginning of the second semester only 55 students answered the questionnaire, i.e. 68.4% of students (perhaps because the registration process had not finished yet). As can be seen, the difference in the number of collected surveys is small.

The results for options for group formation confirm that the solution chosen for the courses at the end of the first semester as well the start of the second semester is the preferred one, namely group

formation based on friendship, and if necessary completion with other classmates. Option 4, i.e. group of friends' selection of a topic from a list, was ranked second.

With regard to topic choice, the survey results reveal a preference for option 9, i.e. the group selects from a list of predefined topics proposed by a company, followed by option 7, i.e. the group selects from a list of predefined topics coming from UPC research works. However, these options are not real; they are intended for information purposes. Option 4, the only realistic one, namely the group proposes several topics, the lecturer comments on them and the group chooses one, came next, which coincides with the lecturer's intuition about the students' preferences. It is also the preferred option at the beginning of the second semester, except by the students in the Eng. Projects course within the Chemical Eng. degree, who prefer option 2, i.e. the group selects from a list of predefined topics.

In summary, the combination between the most voted options for group formation and topic choice means that the students prefer to form groups based on friendship who, in realistic circumstances, propose several topics; these are commented on by the lecturer and then the group chooses one.

Although university project works can represent for students a creative phase of preparation for work in the industry, the survey results showed that, given the chance, students would prefer to choose a topic from a list proposed by a company and receive some sort of compensation which gives them visibility by appearing as authors on publications or as patent inventors. Alternatively, they would accept an economic compensation or a job offer. This issue about compensation requires further analysis work, and the relations between external research to university, and the topics of groups work of the Project course, could be an academic objective in our university.

Several combinations can be used for group formation and topic choice with the aim to achieve high student motivation and increase learning benefits. However, the choice of combination probably depends on the cultural context and circumstances.

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