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Coaching tutors to observe and regulate leadership in PBL student teams or you can lead a horse to water but you can't make it drink…

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ABSTRACT

The purpose of this paper is to investigate how PBL student teams develop specific leadership configurations when implementing interdisciplinary projects and whether or not tutors help in dealing with the group interactions that are subsequently generated. The data set was drawn from 2 cohorts of first-year students engaged in PBL activities in an engineering school in Belgium in 2011 and 2012. Following qualitative content analysis of tutor and student feedback and the use of sociometric testing, findings for 2011 showed that students developed 4 specific leadership configurations, each of them being positively correlated to specific perceived work outcomes. Findings for 2012 were based on using the sociogram as a pedagogical tool to enable tutors to describe and regulate group dynamics. We found that tutors positively perceive their role in facilitating production outcomes but are more uncomfortable when it comes to regulating the interpersonal problems that arise in student self-managed teams.

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INTRODUCTION

To understand how students learn in problem-based learning settings (PBL) requires investigating a number of issues as they relate to its design, implementation and evaluation. For Johnson & Johnson (1991, 1998), the efficiency of learning within student groups depends on the degree of positive interdependence generated as well as on recognizing the importance of individual responsibility. However, putting students in groups and giving them a problem to solve does not guarantee that they will learn and understand the rules of the group in the learning process. The 'natural' tendency of a group in charge of a project is to distinguish between tasks and to specialize in topics, with the group organizing itself to reach the solution. Interpersonal problems may interfere with achieving objectives, giving rise to unequal collaboration by group members (Oakley et al, 2007) and divergence as regards commitment (Wilkerson, 1991; Duek, 2000).

Effective collaborative practices among students may be enhanced when the role of tutors is designed to enable them to critically engage with the learning issues that emerge with PBL approaches (Albanese & Mitchell, 1993). This requires tutors who are trained to facilitate (Raucent et al, 2009) rather than to be 'the teacher in front of the class', a role which newcomers to PBL find difficult to take on. A further issue concerns the approach used to measure collaboration practices and production outcomes. Recent research has shown that although individual assessment tools are no longer deemed sufficient in such settings (Holgard & Kolmos, 2009), the move towards using group assessment tools is still in its infancy. A final issue is that of leadership learning in student teams, where the practice of the shared leadership concept (Barry, 1991) has been positively correlated with team performance (Sivasubramaniam et al, 2002). However, there is as yet little empirical research in academic settings dedicated to examining the impact of teamwork structures on student team performance and learning.

The purpose of this paper is to explore the roles that tutors play in influencing group dynamics created by students when implementing PBL projects. What is the nature of tutors' inputs? How do they understand the leadership configurations manifested in the groups? Do they regulate these leadership configurations and if so, how? The setting used is a PBL project implemented at Ecole Polytechnique de Louvain (EPL) in Belgium. This project, implemented since the year 2000 for first year students, focuses on PBL in three academic disciplines and collective working on an interdisciplinary project (Frenay et al, 2007). The project aims to facilitate learning from a concrete experience through applying the knowledge and techniques acquired through disciplinary problem-based learning, as well as to enhance teamwork skills and to initiate leadership roles.

The paper is structured as follows. The literature review examines student collaborative behaviors, tutor roles and attitudes, assessment practices and leadership configurations as they

relate to PBL in student teams. The methodology, based on qualitative content analysis of student and tutor feedback on perceptions of teamwork processes and performance in the projects carried out in 2011 and 2012, is then presented. This is followed by a presentation of the results obtained, enriched with a set of conclusions.

LITERATURE REVIEW

PBL design promotes socio-cognitive constructive conflicts and collaboration

In his review of problem-based practices within educational theory, Gijselaers (1996) highlights three main principles regarding learning :1) learning is a constructive process, 2) knowing about knowing affects learning, 3) social and contextual factors affect learning. More precisely, Kolmos, De Graaf and Du (2009) found three common learning principles that cut across the different forms of PBL : 1) learning is organized around problems and carried out in projects so as to enhance motivation of students, 2) contents of problem link practice to interdisciplinary theories and is exemplary of overall objectives of curriculum, 3) learning takes place in teams where students learn from each other, share knowledge and are collectively responsible for the learning process, especially the formulation of the problem. The argument for using socio-cognitive conflicts within a team of students originates in the observation that many students have difficulties in using scientific language or have erroneous beliefs. PBL places students in small collaborative groups as a means of confronting them with alternative views of prior knowledge as well as with different problem solving methods. It is argued that experiencing socio-cognitive conflicts among peers helps them overcome false preconceptions by sharing ideas, sharing responsibilities in managing problem situations, leading them to ask new questions (Glaser, 1991, Mandl, Gruber and Renkl, 1993, Bruning, Schraw and Ronning, 1995 cited by cited by Gijselaers, 1996).

We know from educational research that cooperation and collaboration are not automatic student behaviors. More often students either show competition against each other (who is the best performer?) or individualism (work for themselves without paying attention to others), (Johnson & Johnson, 1991). Johnson & Johnson (1998) explain that five conditions are necessary for cooperation to arise: perceived positive interdependence between members (each one understands the task and learning will not occur unless everyone contributes to it), face to face interaction, individual commitment and responsibility, interpersonal skills, and frequent group process follow-up for better functioning in the future. The benefits of cooperation are clear: better production, better learning and also more friendship and higher tolerance for differences in knowledge and abilities among students. According to Roschelle and Teasley (1995), collaboration goes further than cooperation. While cooperation can be achieved through mere coordination of independent tasks, collaboration requires "a joint problem space" where students communicate with each other so as to share the definition of the problem, the goals that they want to achieve, and the actions that are available and that they choose for problem solving. In this collaborative perspective, Kolmos, De Graaf and Du

(2009) argue for PBL alignment among 7 elements of pedagogical design: objectives of knowledge, types of problems and projects, progression and size in curriculum, students' learning, academic staff and facilitation, space and organization, assessment and evaluation. Amongst these 7 elements, the open-problem based and learner-centered approach of PBL refers to 3 elements focusing on collaborative behaviors within a team: tutor's facilitation and process guidance, group assessment and formative evaluation and student's collaborative behaviors.

The tutor's role and attitudes should facilitate collaboration, but…

In PBL literature, a major concern is the role of tutors (Albanese and Mitchell, 1993). Their attitude is seen as a critical factor which impacts students' ability to raise relevant questions and critical learning issues (Williams, 1992, Wikerson, 1995 cited by Gijselaers, 1996). Collaboration can be facilitated if the problem is sufficiently challenging and if the tutor correctly balances a set of various roles (Bouvy, De Theux, Raucent, Smidts, Sobieski, Wouters, 2010). For some researchers, it is also up to the tutor to create groups so that likes and dislikes are optimized as well as to teach students interpersonal skills (Jacques, 2000). The tutor can act as a role model, demonstrating new behaviors towards others, to which students might not be accustomed (Duek, 2000). This role will be effective if tutors show "social and cognitive congruence", that is to say a friendly attitude and the ability to translate knowledge into accessible terms for students (Schmidt and Moust, 1995, 2000).

However, students and tutors appear to lack the necessary vocabulary and knowledge to observe and reflect on real collaboration. Tipping, Freeman and Rachlis (1995, cited by Faidley, Salisbury-Glennon, Glenn and Hmelo, 2000:112), observed a significant gap between tutors' perceptions of PBL teamwork and evidence from videos of the same groups. Raucent, Hernandez and Moore (2009) show that it is very difficult for teachers acting as tutors to observe their own practices objectively and to critically analyze them. Thus it appears that all PBL actors lack indicators to assess what really happens in team collaboration.

Group assessment and formative evaluation: a necessary but complex tool to use

Recent research in PBL expresses concerns regarding the alignment between objectives, activities and assessment as far as collaboration is concerned. A longitudinal survey comparing group and individual PBL assessment in Aalborg University (Hoolgard and Kolmos, 2009) makes this clear. Students, faculty and external examiners find that individual exams test only a limited range of skills compared to group assessment. The latter proved more effective in testing skills related to problem solving, methodological argumentation and theoretical overview and even more so regarding the ability to transfer and transpose knowledge from one area to another. Although group assessment was preferred by the majority of students as well as by faculty and external examiners, authors also observe that individual assessment tools are much more commonly used than group assessment tools.

Another study tested the effectiveness of a portfolio as an assessment tool in a project-based course in electric and electronical engineering (Stojcevski and Du, 2009). Results show that the portfolio is effective in respecting constructive alignment imperatives, but does not account for certain learning outcomes, specifically those regarding collaboration, like project management skills, teamwork skills and understanding of PBL. Another study presents a very interesting assessment tool of collaborative teamwork using peer assessment in a project-based program in engineering (Doucet, 2004). Students evaluate each member's contribution, as compared to their own, using five criteria (initiative, creativity, perserverance, efficacy, ponctuality). The advantage of the tool is that it enables teachers to discriminate collective grades according to the effective contribution of students. But it is not very clear whether students collaborated or simply cooperated. In this faculty, such a practice was accepted by students but compilation of data highlighted rather complicated issues in a different cultural context: French students showed resistance in using this tool when the group had experienced problematic relationships (Verzat, 2009:34). So the tool does not help in understanding processes leading to effective collaboration and how this can be improved.
Drawing on these studies, it appears that assessment tools of collaboration in PBL need more studies to reach consensus on criteria and ownership of assessment, especially when groups encounter problematic relationships between members. Indeed many studies show that collaborative behaviors in PBL groups cannot be taken for granted.

PBL research on students' collaborative behaviors reveals inequality between members and groups.

Although PBL groups are designed to promote collaboration between students, evidence shows that it is not present to the same degree in all groups. Assessment of a project-led program with engineering students in Portugal shows that time, task management and motivation are particularly problematic in teams (Fernandez, Flores and Lima, 2009:52). Other research results also report interpersonal problems in student group-work, due to insufficient trust between members (Huff, Cooper and Jones, 2002, Bianey, Ruiz and Adams, 2004), free-riders (Oakley, Hanna, Kuzmyn, and Felder, 2007), racial and sexual discrimination (Cox, 1996, Faidley et al. 2000), or insufficient ownership (Wilkerson, 1991, Duek, 2000, Wood, 2003).

Cohen (1994), cited by Wilkerson, 1996) concludes that complex, verbalized thinking and social skills will not be displayed automatically by students in groupwork. They have to be trained in those skills. We found three studies that explore students' roles, interaction behaviors and socio-emotional quality within PBL groups. Duek (2000:92) analyzed videos and interviewed tutors and students from 2 sessions of 3 PBL groups in a first-year medical curriculum. Her analysis highlights students' "group functioning roles" and students' "group processing behaviors" which refer to interaction behaviors based on Benne and Sheats' (1978)

categories[1]. She found that there were notably consistent roles played by students: the "discussion dominator", the "holistic big-picture" or "hyper-contributing" student, and the "referencer and silent scribe".

Those roles might contribute to building specific group dynamics observed by Faidley et al. (2000) who analyzed videos of PBL sessions in medical curricula and addressed questionnaires to 20 first-year students of those sessions. Borrowing questions from a survey instrument (CWG Survey, Connolly and Wilson, 1992), they built a "Learning Team Survey[2]" that assesses individual and group perceptions of process and performance. They also elaborated a checklist of the 6 most frequently observable substantive and group processing behaviors[3] with 15 experienced PBL facilitators. Their results describe four types of groups: 1) the Teacher-Dominated or Socratic group, 2) the Student-Negotiated or Transmission group, 3) the Single-Student Dominant or Cautiously Interactive group and the 4) Male dominant or Aggressively Interactive group. Students' perceptions of overall team satisfaction measured by LTS survey, show that model 2 is very satisfactory for all members, model 1 and 3 show very unequal results among the different members, while model 4 is mostly unsatisfactory.

Satisfaction and emotional factors appear be an important feature of groups. An interesting research program on engineering students in PBL programs in Belgium assessed the links between the socio-emotional quality of groups (SEQ) and team members' perceptions of success in having acquired cognitive and interaction skills. SEQ accounts for the level of trust between members and how well they get on with each other. Results indicate that SEQ develops very quickly among a newly formed group of students. It has a strong impact on task performance (Buelens, Van Mierlo, Van der Bulck, Elen and Van Avermaet, 2005), but is only weakly affected by the students' appreciation of what was learned with regard to solving engineering problems and even with regard to acquiring social skills (Heylen, Buelens, Vander Sloten, 2009).

As we can see through those studies, group processing roles, behaviors and emotions are interdependent. Domination by one student or by an authoritarian tutor seems particularly unpleasant and leads to dissatisfaction, poor dialogue and performance. A contrario, perceptions of equality between members and of cognitive but also emotional fit appear to be essential conditions of collaboration between students. But clear indicators of what can be

[1] The possible group processing behaviors are the following : aggressing, derailing/blocking, encouraging/energizing, facilitating/orienting/claryfing, forwarding/initiating/contributing, gatekeeping, hypercontributing/dominating, hypocontributing/withdrawing/following, Observing/participating peripherally, Overtalking, Placeholding, Recognition seeking, Undertalking.

2 This survey comprises 38 questions statistically checked as 7 validated constructs : commitment to purpose, commitment to common approach, complementary skills, accountability, team conflict, team performance, overall satisfaction.

[3] The substantive behaviors are : practice of connecting principles of basic science to case under study, practice of assessing what knowledge is needed to understand the case under study, practice of hypothesizing from a particular set of facts concerning a case. The group processing behaviors are : practice of relatively equal participation of group members, practice of questioning or challenging information or reasoning processes of group members, practice of recognizing contributions of individual group members (complimenting, encouraging, etc…).

regulated by tutor or group members and who assumes ownership for group regulation is not clear. Leadership research can help dealing with this subject.

Another way to explore collaboration in PBL student teams: leadership roles

In self-managed teams, like student teams, there is no formal hierarchical authority. Researchers in social psychology (Levine & Moreland, 1990; McGrath, 1984) and organizational behavior (Bettenhausen, 1991; Sundstrom et al., 1990) explain that team members in such teams need specific interpersonal and self-management skills to perform best. Stevens and Campion (1994) produced a framework of those skills[4]. But a self-managed team's performance is not automatically raised by the presence of skilled individuals. Marks, Mathieu, & Zaccaro (2001) demonstrated that three categories of group processes moderate the impact of team design on group performance in self-managed teams: transition processes, action processes, and interpersonal processes[5].

Those processes require leadership envisioned as a collection of roles or functions that can be held by one or several members. At the individual level, the leader is usually defined as "the individual most likely to direct the activities of other team members" (De Souza & Klein, 1995: 475). But as Barry (1991) pointed out, in the absence of formal authority, self-managed teams are potentially more vulnerable to conflicts and power struggles, and are more inclined to "fission rather than fusion" (ibid.: 32). Envisioned as "a set of functions to be supported by the group" (Gibb, 1954: 884), leadership in self-managed teams may be conceptualized as a "collection of roles and behaviors that can be distributed, shared, swapped, both sequentially or simultaneously" (Barry, ibid.: 34). "Exercising the right role at the right time" seems to be the winning formula, with four leadership roles stressed by Barry. **1) Envisioning leadership** facilitates idea generation and innovation, through setting ambitious goals and identifying links between ideas or systems. **2) Organizing leadership** is concerned with sharing and controlling efficient and effective task completion. These leaders bring together and order disparate elements, with attention to detail, deadlines, and structure**. 3) Spanning leadership** links the team to its external environment through active networking behavior, team image and reputation promotion, while **4) social leadership** allows members to express their needs and concerns, and it ensures that everyone can express his/her opinion.

Drawing on Barry (1991) notion of leadership roles, our purpose in this research is to investigate how PBL student groups develop specific leadership configurations and whether or not tutors help dealing with this issue. Are they aware of the group dynamics at stake? As tutors seem to have difficulties in describing and assessing effective collaboration (Tipping et

[4] Interpersonal skills refer to the ability to manage conflict, to solve problems collaboratively, and to communicate within and outside the group. self-management skills consist in the ability to collectively choose work objectives and track the group progress towards these goals through effective planning and coordination tasks.

[5] The transition processes consist in formulating the group strategy and choosing the objectives to be pursued. Action processes refer to monitoring the group activity in its effort to achieve the objectives, as well as coordinating individual contributions to collective action. Interpersonal processes refer to conflict and emotions management, as well as motivation and confidence building

al.1995, Faidley et al. 2000, Raucent et al., 2009), what kind of tool could help them progress in that field?

RESEARCH DESIGN AND METHODOLOGY

The research context

Using the setting provided by the PBL project work carried out at the Ecole Polytechnique de Louvain, we studied two cohorts of first-year students over two consecutive years (2011 and 2012). In the first week of the school year, a 'kick-off' game such as 'Spaghetti à la Kolb (Kofoed, 2003; Raucent et al, 2007) is proposed to enable students and tutors to begin reflecting on collaborative learning. Students also receive extensive tutor support to help them reflect on group work and in particular on the importance of rotating roles such as time keeper, moderator, secretary and scribe. Normal school activities begin in week 2. This includes problem-solving in mathematics, physics and computer engineering and a 12-week interdisciplinary project. The tutors play a particular role in facilitating all activities (Raucent et al, 2009) and are present with the teams at regular intervals throughout the weekly meetings. Each week, groups have to provide an assessment of the group relationship and report on this subject after the preliminary jury (week 5/6). The tutors provide feedback on the quality of the group work and are expected to instigate group reflection practices. Controversial exchanges are encouraged to enable the students to gain self-confidence in their teamwork effectiveness, particularly as regards leadership distribution. The tutors are PhD students in engineering domains. Some have followed the EPL curriculum and have therefore experienced PBL and project work as students. Some come from other institutions and they do not necessarily share the same idea of what PBL is. In 2011, the student intake was 360 (60 groups) and in 2012, there were 62 groups.

Data collection and analysis

To identify group interactions, leadership distribution and tutor behaviors, we collected and analyzed the feedback provided by students and tutors, using qualitative content analysis. The methodological approach included the following 3 phases.

Step 1: Discovering leadership configurations through analysis of students' 2011 qualitative reports

Two sets of documents – an individual confidential report on team progression and teammates' performance (submitted in week 5) and a collective report on teamwork progression (week 6) were analyzed by two researchers. This analysis focused on group perceived performance and group processes that team members implemented to organize their work. Group perceived performance was examined according to Hackman's (1987) criteria of team effectiveness. A sociometric test (Moreno, 1953, Mescon, 1959; Lucius and Kuhnert,

1997) was used to identify group structure and roles, revealing the density of each group[6]. This was measured by the number of ties that connect members with one another. These ties (either reciprocal or one-way) were identified according to students' answers to the question in the confidential report "Who do you prefer to work with"? A sociogram was developed for each group, displaying the number of interactions that occurred between members. Interactions in each group varied from very low (5) to high (19).

Step 2: Qualitative questionnaires on the 2011 tutoring experience and analysis of tutors' opinion in final juries.

16 debriefing questions were sent by mail to the 8 2011 tutors. 7 (2 female and 5 male) returned the questionnaire. Each tutor was in charge of 8 PBL groups. Questions (see Annex 1) addressed 4 issues regarding tutor's experience and perceptions: 1) observation of characteristics and progression of their groups, 2) explanation of their interventions as tutors and perception of their impact, 3) perception of roles and feelings as tutors, 4) perceptions and desires regarding available support for tutors. A qualitative synthesis of these perceptions was conducted by an independent researcher. At the same time, tutors' reports at the final jury were analyzed by the same researcher to explore the degree of precision of their qualitative observations on group dynamics in each of the groups tutored in step 1.

Step 3: Experimentation and interviews with 2012 tutors about a regulating tool based on sociometric tests.

In 2012, the same kind of project took place with the intake of first year students. 10 tutors were recruited to coach the 62 student teams. All tutors were PhD students in engineering domains: two of them had been tutors in 2011 in the same project, 4 were newly recruited tutors with tutor training, 2 were newly recruited tutors without tutor training and 2 came from a foreign institution and had never studied in a PBL curriculum.

To enable more rapid and efficient analysis of the confidential student reports (week 6), a computerized tool was designed to automatically draw the sociogram for each group. After the preliminary jury (week 7), all tutors had an exhaustive view of relationships in their groups. This was based on the anonymous sociogram and the group report. Drawing on results from Step 1 and Step 2, debriefing with the tutors were organized by the professor in charge of this PBL program after the preliminary jury. The aim of these meetings was: 1) to provide a tool (the sociometric test with anonymous typical examples) to help tutors be more precise about their observations of groups, 2) to build a regulating tool together (how could or should they intervene in such cases?). Then, considering the initial disappointing results of

[6] Mescon (1959) explains Moreno's sociometric method and applies it to leadership analysis. Sociometry is a "method of studying interpersonal relations in terms of attraction-repulsion patterns existing among group members. [ ] This sociometric technique maps these relationships quantitatively by having each member, for instance, list the persons in the group whom s/he likes most or least. By collecting these responses, it is possible to draw a structural map of the group in terms of the bonds holding the accepted members in and those tending to expel the rejected members" (p22). This technique has been used in educational settings to identify affinities between students (Vasquez & Oury (1971), Vayer & Roncin, 1987) but also in workplace settings to test the relationship between group density and satisfaction and perceived cohesion between members (Lucius & Kuhnnert, 1997). It is currently used in social network analysis (Lemieux & Ouimet, 2004)

those meetings (see results below), interviews were conducted by an independent pedagogical consultant with each tutor. These interviews attempted to gain richer information on tutors' perceptions of their observation and regulation role regarding leadership in groups and about the proposed tool based on the sociometric test. A preliminary synthesis of these interviews is proposed in step 3 below.

RESULTS

Step 1: 4 typical group configurations identified in the 2011 cohort

The analysis of collective and individual reports enabled the identification of four leadership configurations that emerged in the student teams (Verzat, O'Shea, Radu-Lefebvre, Raucent, Fayolle, Bouvy, 2012). The first category, "Waiting for Godot", (see a typical sociogram for this group in Figure 1a) comprised groups who did not succeed in organizing themselves in roles and task sharing and where no leadership strategy emerged. The working patterns adopted by groups in the second category may have initially created the illusion that some kind of leadership emerged but the potential generated by the "foot soldiers" petered out because of "hangers-on" who displayed a more passive attitude (see Figure 1b). The third category comprised groups (see Figure 1c), characterized by the emergence of "organizing leaders" who took command relatively late in the process to "save" the team and mobilize members to ensure a reasonable performance. The groups in the fourth category chose to distribute leadership roles among members, achieving a high level of satisfaction as regards their collective outcomes (Figure 1d).

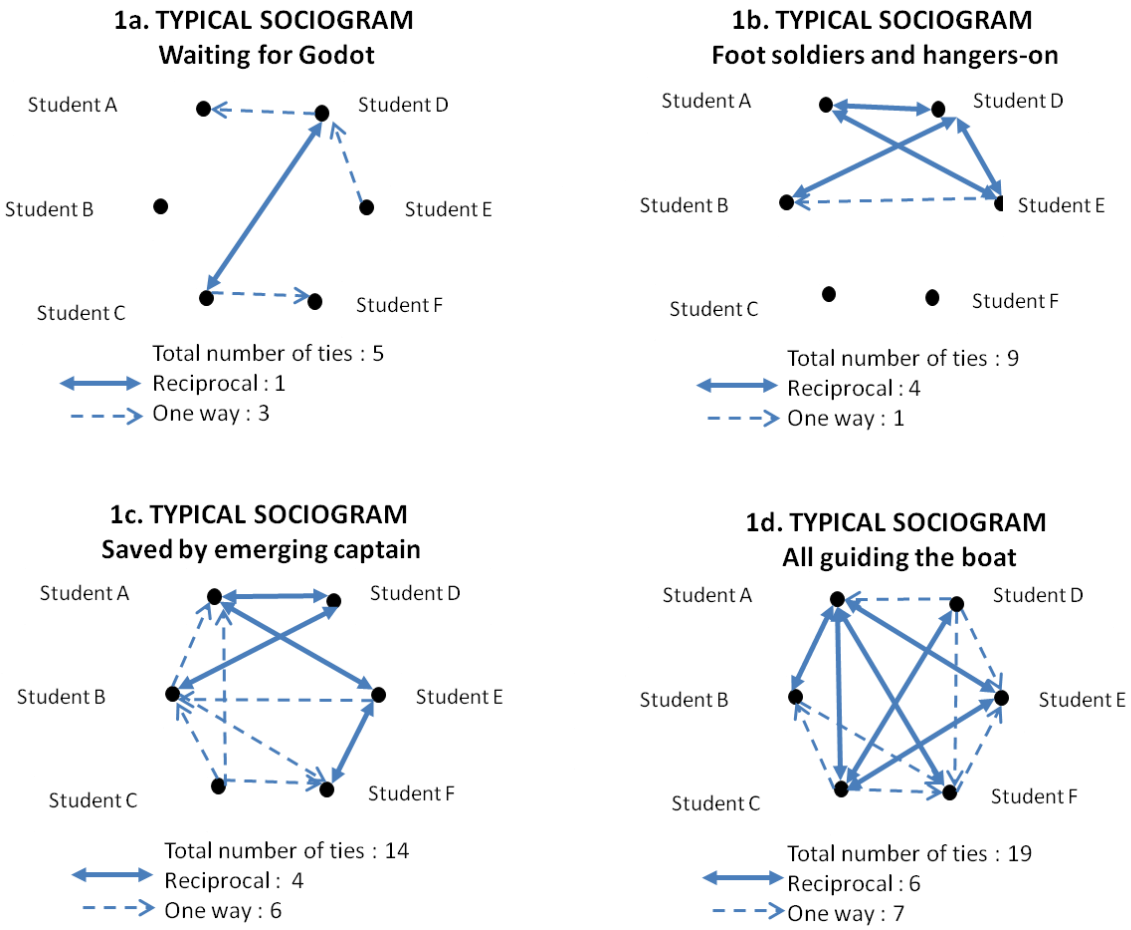


Figure 1 (a, b, c, d): Typical sociograms reflecting 4 leadership configurations

Step 2: Tutors' perceptions and behaviors with regard to the 2011 cohort

The analysis of the 7 questionnaires firstly reveals overall agreement with regard to tutors' perceptions of their roles as positively facilitating production outcomes in the student teams. Tutors generally perceive their roles as presented below ranked according to the number of times they were mentioned in the questionnaires:

- Expert (provide input on technical matters)
- Supervisor, timekeeper (make sure students respect rules and deadlines)
- Policeman (maintain law and order in groups)
- Guide, coach (structure work and progress; put them on the right track)
- Motivator (encourage them when they are floundering)
- Mediator (teach them to share knowledge and competencies)

They perceive this input as being useful, without which the students would not reach their objectives, and satisfaction is measured through linking the quality of their inputs with the groups' final outputs.

Secondly, there is a consensus on the nature of the difficulties they experienced which they consider prevented them from working efficiently. Role rotation is often considered artificial by tutors; they report that students are not convinced of its utility and they perceive a more

natural distribution of roles in terms of students' social and cognitive competencies. Despite these criticisms, some tutors observed that their groups perceived the utility of role rotation either too late, or when the workload increased, as this helped them plan and progress. Tutors often appear to be overwhelmed by the multiplicity of the roles they must play in what they consider to be a very limited timeframe. Some even plead for the presence of a second tutor to effectively observe group collaboration. Mirroring the negative feedback from students regarding the quantity of evaluation reports required, tutors commented on their generally botched nature, estimating that they were of little value.

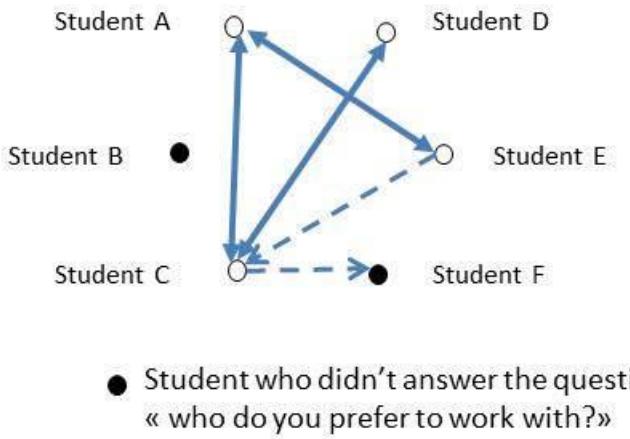
Thirdly, however, there is less agreement with regard to the role of the tutors in regulating problematic teamwork behaviors. This is reflected in the fact that some tutors apparently never encountered problems that required regulation; others seemed a little helpless when faced with students who did not pull their weight and 2 tutors called on the project supervisor to regulate conflicts that had arisen in their groups. Some tutors also expressed discomfort with the students' confidential reports, particularly as regards the question "who do you prefer to work with", judging this to encourage a denunciatory type of behavior and even questioning the ethics of such a document.

Despite the difficulties presented above, the tutors expressed satisfaction with what they considered to be the constructive behaviors of students which enabled them to focus on their work. This is corroborated to a certain extent by an analysis of the final marks obtained by a cross-section (24 groups) of the 4 leadership categories identified in the 2011 cohort. The marks varied from 11 to 17 on 20 with an average of 14 for categories 1 and 3 and 14,5 for categories 2 and 4. The highest marks (16 and 17) were attained by 2 groups in categories 3 and 4 respectively, with the lowest (11 and 12) in groups 3 and 1 respectively. However, further analysis of each tutor's marks and commentaries in relation to group performance within the different leadership configurations is still required.

Step 3: 2012 tutors' reactions to the regulation tool based on sociometric tests

In week 7, during a tutors' coordination meeting, the 10 tutors were invited to react in groups to the presentation of 12 typical anonymous examples drawn from the 62 groups analyzed. Immediate reactions were rather ambivalent. Firstly, tutors expressed uneasiness and mistrust of the test. The general feeling was that the question "who do you prefer to work with?" was too narrow: "The question does not enable them to express the degree of preference", "It would have been interesting to have asked the reverse question", … On the other hand, the different anonymous examples provoked immediate recognition of situations where they were confronted with real problems.

Figure 2a
Godot example in 2012



A striking example (see figure 2.a) is an anonymous example of the Godot category where the sociometric test reveals that some students did not want to answer the question "who do you prefer to work with ?" and where the other students did not choose them either. Immediately tutors recognized that "There are real problems with certain students in some groups because nobody wants to work with them".

Figure 2b
Hanger-on in 2012

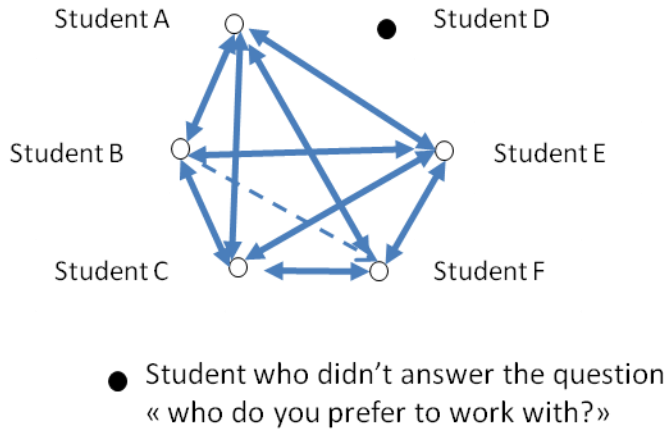


Figure 2.b, shows another example of a situation where the sociogram identifies the non-participation of one student in a particular group. The problem was reported to the tutor by a concerned student in the group and this enabled him to confirm his intuitions about problematic group interaction during an exchange with the project supervisor. However, the tutor did not appear to be able or willing to regulate this issue by himself.

When tutors were invited to go a little further in the discussion about what they could propose so as to react to such situations, they expressed the same embarrassed position. On the one hand they recognized that there were interpersonal problems within groups that should be dealt with. But on the other, they tended to refuse proposing their own solutions. As a result, it was impossible to obtain their collaboration in completing the tool with suggestions for regulation practices or to have any authentic discussion in the tutor group on this topic. However, some tutors subsequently started private discussions with the professor in charge of the project (first by email, then orally).

Interviews with tutors carried out by an independent consultant went deeper into their perception of this tool, and attempted to pinpoint perceptions about what really happened in groups to highlight their roles in group dynamics regulation. A preliminary synthesis of these interviews extends our comprehension on this matter.

Firstly, the tutors generally believe that they are responsible for the effective functioning of the groups. They are particularly at ease when it comes to facilitating group production, not hesitating to orchestrate students' activities. Because they are focused on production outcomes, they can easily identify and challenge students who do not pull their weight. However, they are much more uncomfortable when it comes to regulating the social dynamics manifested in the groups. They recognize that motivation is essential but they find it difficult to understand how it operates from one group to another. They have a tendency to allow the groups to organize themselves because they are unsure about how to facilitate role rotation and even question the utility of imposing roles such as that of moderator. They do not consider that their role is to influence the group climate, leaving this up to the students, nor do they intervene to regulate interpersonal difficulties experienced in the groups.

Secondly, findings also demonstrate differences in the attitudes the tutors have concerning their role. Those who are focused on production outcomes tend to manifest a more directive style, challenging the students to work, reminding them of rules and deadlines, including those who appear to be lagging behind. Those who are interested in motivating students tend to play the role of facilitator, putting the onus on students to take on responsibility for group outputs.

Finally, the sociometric tests reveal group interactions with which tutors are not very familiar and which they have difficulties in mastering, such as why some students are excluded or some work well together. While this may explain their reticence in using the regulating tool proposed, it is interesting to note that at least some of the tutors recognized its utility in dealing with extreme cases or with groups that function badly.

DISCUSSION AND CONCLUSION

If we sum up findings from steps 2 and 3, tutors seem to accept and enjoy their role as facilitators in PBL student groups. Their official discourse shows that they are aware of taking on different attitudes and roles which relate to the needs expressed by groups at particular times and in various situations. These attitudes and roles are reflected in the three coaching postures as applied to students, described by Verzat, Raucent and Villeneuve, (2010) following Paul's model of 3 coaching professional postures inherited from the Greek culture (Paul, 2004) : expertise-driven, action-oriented and hermeneutical.

Our findings suggest that PBL tutors that come from engineering backgrounds, and who have experienced PBL themselves, are more comfortable with the production oriented posture, than with the social regulation of groups. This is in line with previous research on tutors' limited capacity to assess and guide social group dynamics (Tipping, Freeman and Rachlis, 1995, Raucent et al., 2009, Stojcevski and Du, 2009, Hoolgard and Kolmos, 2009). We also found that tutors have different styles and attitudes, some more authoritarian and others more facilitating, which may contribute to different configurations in student-tutor relationships (Faidley et al, 2000).

Results from Step 1 showed that the sociometric test is a useful tool for assessing leadership configurations leading to performance, learning and satisfaction in student groups. Steps 2 and 3 tested the sociogram as a pedagogical tool that should enable tutors to describe and regulate the social dynamics of student groups under their charge. Our results show that the sociogram is a useful tool for observing the ways group function and how leadership manifests itself, corroborated by the higher marks attained by groups in categories 3 and 4 in 2011. However, we also found that tutors are not comfortable with a tool that highlights ambivalent zones in which ownership for regulating remains fuzzy. While it seems legitimate for tutors to focus on production and deadlines in groups where no leader emerges, helping to solve intepersonal conflicts or to foster implication, motivation or socio-emotional quality in groups seems to be left up to the students. As this in itself is a major source of dissatisfaction among them, clarity about who should regulate here would alleviate these difficulties.

Even if the test reveals uncomfortable situations for the tutors, the sociogram proves very useful in critical cases. The researcher who collected and analysed the data in step 3 reported that tutors came to the interviews armed with the sociometric drawings of their difficult groups and became more open about trying to find solutions. Individual (rather than group) meetings between tutor and teacher on ways of using the tool appear to be effective, given that tutors are looking for personalised advice to give to problematic groups. Further research is required to devise a solid methodology in using the sociogram for regulating interpersonal issues in PBL student teams.

Annexes

Annexe 1 : Qualitative questionnaires on 2011 tutoring experience.

1. How did your different groups manage ?
2. Did you encounter specific difficulties with one of the groups you were tutoring ? Which group and which difficulties ?
3. What are common features of all groups ?
4. What characterizes each group ? (for example, group progression, group dynamics in terms of roles and leadership...)
5. How do you perceive each group evolution ?
6. When did you have to intervene (systematically, at certain steps, because of certain observations or perceptions, why, can you illustrate with a situation ?)
7. Did your intervention have an impact on group dynamic ?
8. Generally, how do you perceive your role as a tutor ?
9. Why is this role necessary ? What does it useful for ?
10. How is this role perceived by students ?
11. What is easy or difficult to assume (illustrate with precise situations)
12. What are your main satisfaction or deceptions ?
13. What kind of support do you get to help as a tutor ? is it efficient ? necessary ... ?
14. What is missing in the training/preparation/ support you get as a tutor ?
15. ideally what could be useful for you to help you as a tutor ? (for example, training on a particular subject, support or dialogue with somebody, tool...)
16. Other comments you would like to add...

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