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Evolutionary trends of problem-based learning practices throughout a two-year preclinical program: a comparison of students' and teachers' perceptions

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Abstract Implementation of a pedagogical approach is a continuous and evolving process. As an institution with more than 15 years problem-based learning (PBL), we studied how the learning and teaching processes are currently practiced in a 2-year preclinical basic sciences program to assess whether they still match the intended objectives. Using both students' and tutors' evaluations, we analyzed and compared their perceptions on the program content and its organization, on tutors' functioning and on the duration of PBL sessions throughout 11 instructional units of the second and third-year of a 6 years medical curriculum. Whereas both tutors and students indicated that the content and problems selected for the curriculum were well adapted to the PBL process, they felt the references as well as the self-study time as moderately appropriate. Over the course of the 2-year program, tutorial sessions got linearly shorter, whereas reporting sessions got longer. While tutors knew well the PBL approach and were suitably prepared to their tutorials, they however, became less regular in providing feedback and in evaluating group functioning over the 2 years. Our results suggest that the practice of the PBL process evolves within and throughout a 2-year preclinical program and moves away from the original intentions. Possible underlying reasons and their implications are discussed within the context of tutors' and students' concepts of teaching and learning, the medical schools' learning environment and teaching practices and the difficulty of developing and maintaining in the long term a deep and self-directed learning approach.

Keywords Curriculum · Education · Medical · Undergraduate/methods · Learning · Medical students · Models · Educational · Perception · Problem-based learning/methods · Program evaluation · Teaching · Method/practice

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Introduction

Since its introduction 40 years ago, problem-based learning (PBL) has been adopted by many medical schools. While the very first studies focused on the feasibility of implementing the method, successive ones have investigated the efficacy of the approach on students' learning and acquisition of clinical competency. The results had been at most ambivalent on the approach's effectiveness or ineffectiveness given the studies' various conceptual methodology, design, and outcome criteria used (Hamdy 2008; Taylor and Miflin 2008). Most commonly, the studies considered PBL as a general construct with little consideration of the complexity of its implementation and the multiple factors which could act and influence the outcomes of the approach (Norman and Schmidt 2000; Dolmans et al. 2005; Mamede et al. 2006; Newman 2006; Svinicki 2007; Neville 2009; Ravitz 2009; Schmidt et al. 2011). In particular, investigations regarding "complex interactions between the learning-assessment environment, students' perceptions of assessment demands, and students' approach to learning" demonstrated that "Implementing a constructivist learning and assessment environment does not directly lead to a change in students' approaches towards more deep learning" and that "the power of (the perceived) assessment to steer learning is both limited and complex" (Gijbels et al. 2008). In others words, it may not be sufficient to provide a constructivist learning environment and to change the assessment to bring students to change their perceptions of learning and approach to deep learning (Marton and Saljo 1997; Vu et al. 1998). It was further found that students' learning may be influenced by tutors' role and functioning (Dolmans et al. 2001; Van Berkel and Dolmans 2006; Chng et al. 2011), their approaches to teaching (Richardson 2005), and the specialty or the organ system or unit of instruction they are involved in tutoring (Norton et al. 2005).

As with the applications of any curricula and instructional models at the university teaching level, the implementation of the PBL approach is also a continuous, evolving and challenging process and the follow-up and study of its practices (Fullan and Pomfret 1977; Ravitz 2009) are very much needed to monitor how the processes actually function with time in order to "assure the continued delivery of high quality medicine" (Jones et al. 2001). Until now, few institutions with a long history of PBL implementation have reported how its processes are currently practiced (Neville and Norman 2007).

Since the implementation of the PBL approach more than 15 years ago at our institution, we have systematically evaluated and monitored the practice in PBL tutorial sessions (Vu et al. 1997). This follow-up allowed us to determine that the program and its approach of teaching and learning have been consistently well evaluated by the students. However, while the evaluation of the program by the students is valuable, it is not sufficient (Berk 2005). Indeed in the last few years, remarks and informal discussions with both teachers and students at our institution pointed to the observation that "PBL as practiced is not the same anymore". Needing to validate these observations, we decided to gather the teachers' appraisal of the teaching program and to combine them with those of the students in order to derive a comprehensive and complementary assessment of the program (Kaufman and Holmes 1996; Marsh and Roche 1997).

The purpose of this study is to analyze the current PBL practice throughout the second and third year of the basic medical sciences program in order to determine whether it still matches the original intended objectives and facilitates students' active, self-directed and deep learning. We investigated (1) whether students and tutors have similar perceptions of the strengths and weaknesses of the program (2) how tutors appraise their own role and functioning compared to students (3) whether the tutors' and students' practices differ between

various preclinical instructional units (4) whether these practices evolve during the passage of the cohort of students throughout the program and (5) if yes, what factors can explain it. Towards these purposes, we compared the students' and the tutors' perceptions on (1) the overall 2-year PBL preclinical curriculum, (2) the tutors' functioning and the factors which may influence their teaching effectiveness (3) the duration of the tutorial and reporting sessions and the factors which may affect them and (4) whether the findings vary across the PBL instructional units and throughout the 2-year preclinical program.

Methods

Setting

The study was conducted with medical students and tutors teaching in the second and third year of a 6-year integrated curriculum. Overall, the first year is in great part based on large group lectures, while the second and third years consist largely of small group problem-based learning tutorials complemented by lectures, seminars, discussion forums and laboratory activities. Learning activities of the last 3 years of the program (clinical clerkships and electives years) consist of direct patient encounters and a combination of case-based problem-solving learning, tutorials, clinical activities, lectures and seminars. Further details on the curriculum were reported earlier (Baroffio et al. 1997; Vu et al. 1997).

The second and third years are organized into 11 integrated preclinical instructional units (PIU), each lasting an average of 4 weeks and ranging from 2 to 10 weeks. The 11 PIUs are divided into 7 PIUs in the second year (Introduction to PBL; Cell growth and aging; Nutrition, digestion and metabolism; Reproduction; Heart and circulation; Excretion and homeostasis; Respiration) and 4 PIUs in the third year (Locomotion; Perception, emotion and behaviour; Defense and immunity; Infections).

In each PIU, students are exposed to 4–8 problems. Each problem is studied in two sessions, the tutorial and the reporting sessions that are typically scheduled for 2 h (with one exception which is the Unit of Nutrition, digestion and metabolism which has its reporting sessions scheduled for 3 h). In the tutorial session, a group of 8–10 students analyze and attempt to explain the studied problem and derive the needed learning objectives. With the derived objectives and the faculty's provided reading references, the students start their self-directed study to acquire the needed additional information. About 2–3 days later, they reconvene in the reporting session to put together their acquired new knowledge to further explain and answer the questions asked in the problem. They finish the session by analyzing their learning processes, their newly acquired knowledge and their group functioning. Both sessions are carried out with the tutors, whose role is to guide the students' learning and processes of analyzing and explaining the problem, to encourage the group communications and collaborations, to help students in analyzing group functioning, and in particular whether they attained the set learning objectives and to provide students with feedback. The PBL teaching and learning processes are introduced and practiced by the students at the start of the integrated PBL curriculum, i.e. the first 2-week Introduction unit of the second year program.

Subjects

The study's subjects were recruited during the academic year 2005–2006. They included 115 second year medical students, 98 third year students, and 212 second and third year PBL tutors. The average number of tutors per PIU was 18 (Range:13–28 tutors).

Instruments' design and administration

Data obtained from the students were derived from an 18-item program evaluation and a 17-item tutor evaluation questionnaires systematically administered at the end of each PIU. These 2 questionnaires have been adapted from the one developed at Sherbrooke Faculty of Medicine and Health Sciences and Maastricht Faculty of Health, Medicine and Life Sciences. They show stable reliability coefficients at the long-term (Gerbase et al. 2012). The original tutor evaluation questionnaire has been validated (Dolmans et al. 1993) and its adapted version described in an earlier paper (Baroffio et al. 1999).

Data obtained from the tutors were derived from a 50-item electronic survey evaluation questionnaire which was especially developed for this study and administered during the academic year 2005–2006. It has been designed to derive tutors' views on the program and on their own functioning, and has not been validated.

For the present study, ten common items from the students' and tutors' questionnaires were selected for analysis. Specifically, there were four items concerning the program. They determine whether (1) the Unit content is adapted to the students' prior knowledge, (2) the problems are suitable to the PBL format, (3) the references are appropriate to analyze the PBL problems, and (4) the self-study time is sufficient. There were four items regarding the tutor. They assess whether the tutors know the PBL teaching approach, are prepared to PBL problems, provide regular feedback to students and discuss the functioning of the group. Students and tutors rated these 8 items using a 5-point Likert scale (1= strongly disagree; 2 = disagree; 3 = moderately agree; 4 = agree; 5 = strongly agree). Finally, there were two items in which tutors and students estimated the average length of their tutorial and reporting sessions.

Statistical analysis

Using inferential analysis, data are presented as mean ± standard deviation. General linear models (multivariate analysis) were used to compare the evaluation ratings of students and tutors (fixed factor: respondent) across PIUs (fixed factor: PIU). Polynomial contrasts were used to analyze the change of students' and tutor's ratings throughout the second and third year program. We ran a regression model to test the factors which may affect tutors' perception of providing students with feedback, and students' perception of having received feedback from the tutors (tested factors: tutor knows PBL approach, tutor is prepared to unit content, tutor discusses group functioning with students, position of PIU within the 2-year preclinical program). Two additional regression models were conducted to test the factors influencing tutors' and students' estimates of the length of the tutorial session (tested factors: quality and appropriateness of the PBL problems, students' prior knowledge, position of the PIU within the 2-year program) and of the length of the reporting session (tested factors: quality and appropriateness of the PBL problems, students' prior knowledge, appropriateness of the given references, length of the tutorial session, students' perception of having adequate self-learning time, position of the PIU within the 2-year program).

Results

From the 115 second year and 98 third year medical students, we had respectively an average return rate of 74 and 58 % on the evaluation questionnaires, or a total of 828

individual students' evaluations across PIUs. The return rates for individual PIUs were higher than 70 % for 8 of them, around 60 % for 2 and 23 % for 1 (Perception, emotion and behaviour). Of the 212 tutors surveyed, 150 (71 %) completed the questionnaire.

Program evaluation

On a scale from 1 to 5, both tutors and students rated on average highly and similarly the relevance of the PBL problems and the adequacy of the unit content in regard to students' prior knowledge (Table 1). Furthermore, students' ratings of the unit content adequacy showed a slight but consistent decrease across the 11 PIUs. Regarding the PIU's references and self-study time, both students and tutors considered them as moderately appropriate, but students' evaluations were more severe and lower than those of the tutors. In addition, these evaluations varied across the PIUs for tutors and students. It should be noted that the students' ratings of the program used in this study were representative of students' overall appreciations since they were similar to those obtained in the following two academic years 2006–2007 and 2007–2008 ($p = 0.596$).

Tutor evaluation

Overall, students were highly satisfied across all PIUs with the tutors' knowledge of the PBL process and their preparedness in tutoring PBL problems (Table 1). However, they rated moderately the tutors' regularity in providing feedback and discussing the group functioning. Regarding the tutors, their appreciation of their own role and functioning was overall good but it differed from the students on the following points: tutors under-evaluated their knowledge of PBL approach, preparedness in tutoring, and regularity in providing feedback to the students, and over-estimated their regularity in having discussions on the group functioning. Tutors' knowledge of the PBL process and their preparedness in tutoring PBL problems did not vary across PIUs. In contrast (Fig. 1; Table 1), tutors' regularity in providing feedback and in discussing group functioning varied across PIUs and were found in addition to diminish throughout the second and third year preclinical program (Polynomial contrast estimates). In a separate institutional evaluation monitoring program, similar findings were replicated for the next three academic years (06–07, 07–08 and 08–09: $p = 0.902$) and with the three respective cohorts of students ($p = 0.221$) suggesting the stability of the present findings.

A regression analysis indicated that discussions regarding group functioning greatly contributed to both the tutor's perception of having provided students with feedback and students' perception of receiving the tutors' feedback (Table 2). For both the tutors and students, these perceptions varied overtime with the PIUs, and most specifically those of the students. Overtime, students' perception of having received tutors' feedback was further reinforced by their perception of the tutors' knowledge of the PBL process and their preparedness to the problem content.

Lengths of tutorial and reporting sessions

Both students' and tutors' estimation indicated that in average the tutorial session (1.7 h) was usually shorter than the reporting sessions (>2 h) (Table 1). Tutors' and students' estimates of the duration of the tutorials were equal, whereas students' estimates of the reporting sessions tended to be longer than those of the tutors. Both the length of the tutorial and reporting sessions significantly differed across PIUs. Polynomial contrast

Table 1 Comparisons between tutors' and students' ratings (Mean ± SD, F-ratio, p value, R^2, and polynomial estimate) of items (1 = strongly disagree, 5 = strongly agree) on the program and tutor evaluation questionnaires and duration of PBL sessions (in hours) for the preclinical instructional units (PIUs) in the second and third basic medical sciences years

	Mean ± SD	Respondents		PIU		R^2	PIU linear polynomial contrast	
		F	p	F	p		Estimate	p
Program evaluation								
PIU content is adapted to prior knowledge								
Tutors[a]	3.99 ± 0.97							
Students[b]	3.97 ± 0.98	0.155	0.694	1.848	0.049	0.05	−0.354	0.015
Problems are suited to PBL								
Tutors[a]	4.19 ± 0.75							
Students[b]	4.05 ± 0.96	3.567	0.059	1.163	0.313	0.055		
References suit problems								
Tutors[a]	3.56 ± 1.09							
Students[b]	3.33 ± 1.19	9.994	0.002	4.315	0.000	0.098	−0.069	0.685
Self study time is sufficient								
Tutors[a]	3.47 ± 1.23							
Students[b]	3.20 ± 1.23	11.391	0.001	5.774	0.000	0.129	−0.327	0.061
Tutor evaluation								
Tutor knows PBL approach								
Tutors[c]	4.15 ± 0.92							
Students[d]	4.39 ± 0.48	10.593	0.001	0.85	0.581	0.072		
Tutor is prepared to PIU content								
Tutors[c]	4.06 ± 1.00							
Students[d]	4.51 ± 0.54	30.047	0.000	0.632	0.786	0.112		
Tutor provides feedback								
Tutors[c]	3.60 ± 0.99							
Students[d]	3.89 ± 0.69	13.612	0.000	5.103	0.000	0.175	−0.779	0.000
Tutor discusses group functioning								
Tutors[c]	3.71 ± 0.94							
Students[d]	3.40 ± 0.83	12.218	0.001	8.169	0.000	0.259	−1.018	0.000
Sessions' length								
Tutorial session (h)								
Tutors[e]	1.67 ± 0.36							
Students[f]	1.66 ± 0.39	1.343	0.247	8.646	0.000	0.203	−0.396	0.000
Reporting session (h)								
Tutors[e]	2.09 ± 0.32							
Students[f]	2.22 ± 0.60	9.091	0.003	2.553	0.010	0.114	0.329	0.000

Three general linear models (multivariate analysis) were run to compare students' and tutors' (fixed factor: respondent) evaluation ratings across PIUs (fixed factor: PIU) for the program, the tutors and the sessions' length. Polynomial contrasts were used to analyse the change of students' and tutor's ratings along the 2-year program. The number of tutors and students varied with the different items on the program and tutor evaluations: [a] n = 147; [b] n = 719; [c] n = 150; [d] n = 235; [e] n = 115; [f] n = 637

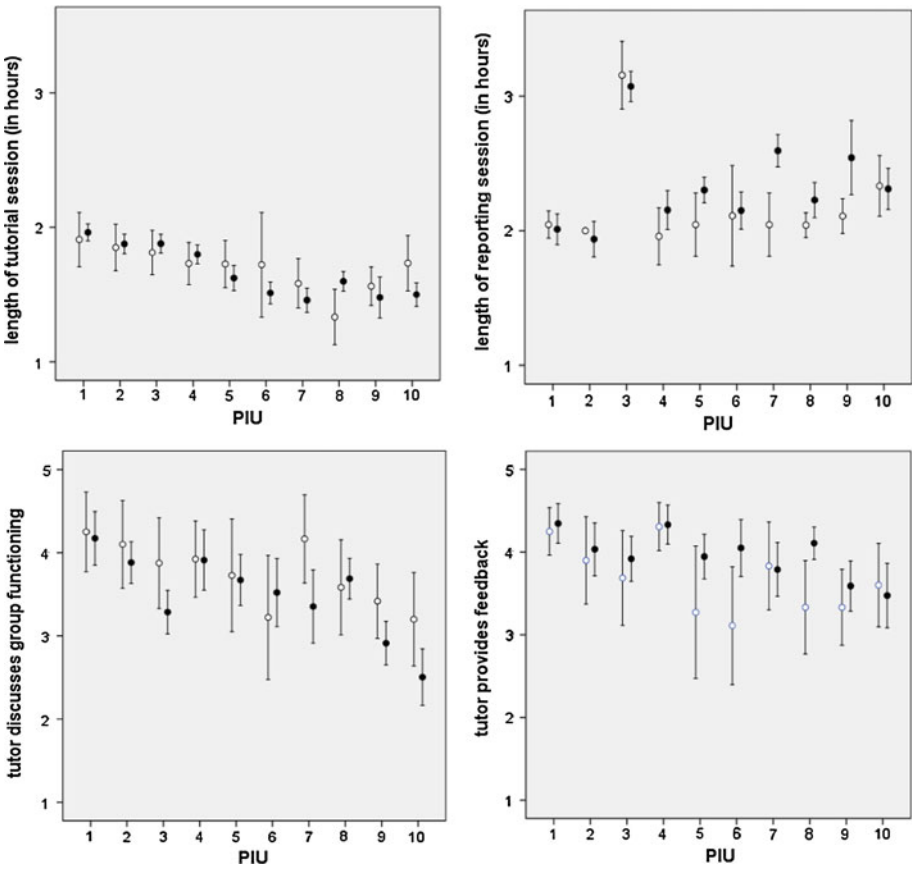

Fig. 1 Students' and tutors' estimations (mean, 95 %CI) of the duration of PBL sessions, and ratings of the discussion on the group functioning and feedback provided by tutors to the students. Tutors (*white dots*) and students (*black dots*) estimated the duration of tutorial and reporting sessions of the PIUs (in hours), and rated (1 = strongly disagree to 5 = strongly agree) on whether the tutors had provided discussions on the group functioning and feedback to the students. The PIUs are listed in the sequence they occurred in the second and third years. PIU #3 reporting sessions are scheduled for 3 hours as compared to the usual 2 hours for all other PIUs. PIU #11 is not shown since students' estimations of the tutorial and reporting session's duration were missing

estimates revealed, that overtime while the second and third year tutorial sessions tended to get shorter, the reporting sessions tended to get longer (see also Fig. 1). Interestingly, the summed length of tutorial and reporting sessions stayed stable and showed no trend overtime, suggesting a potential inverse relationship between them. As above, similar trends of the lengths of tutorial and reporting sessions were replicated in students' evaluations of the following two academic years (06–07 and 07–08: $p = 0.110$ and 0.262 for tutorial and reporting sessions respectively) and for one cohort of students throughout the second and third year (cohort 06–08: polynomial contrast estimate $= -0.401$ and $+0.243$ for tutorial and reporting sessions respectively; $p < 0.001$).

Regression analyses suggested that estimates of the length of the tutorial session by the tutors and students depended neither on the quality of the PBL problems, nor on students' prior knowledge. However, it seemed to depend mainly on the timing or position of the

Table 2 Kendall correlations, Beta regression coefficients, and R square between selected tutors' competencies and their providing of feedback to the students

Criterion: tutor provides feedback	Tutors[a]			Students[b]		
Predictors	Correlations	Regression		Correlations	Regression	
		Beta	*p*		Beta	*p*
Tutor knows PBL approach	0.258**	0.113	0.212	0.742**	0.451	0.000
Tutor is prepared to the PIU content	0.233*	0.089	0.319	0.538**	0.212	0.000
Tutor discusses group functioning	0.423**	0.335	0.000	0.642**	0.361	0.000
PIU order of sequence[c]	−0.264**	−0.178	0.019	−0.298**	−0.115	0.005
R^2		0.241	0.000		0.716	0.000

This regression model tests whether the fact that tutor knows PBL approach, is prepared to PIU content and discusses group functioning with students, and the position of PIU within the 2 year preclinical program (1–11) predict the perception of tutor of providing students with feedback, and the perception of students having received feedback; * $p \leq 0.01$; ** $p \leq 0.001$; [a] n = 150; [b] n = 235; [c] PIU order of sequence within the 2-year preclinical program

Table 3 Kendall correlations, Beta regression coefficients, and R square between selected PBL session characteristics and the length of the reporting session

Criterion: length of reporting session	Tutors[a]			Students[b]		
	Correlations	Regression		Correlations	Regression	
Predictors		Beta	*p*		Beta	*p*
Length of tutorial session	0.183*	0.240	0.011	−0.014	0.089	0.037
PIU order of sequence[c]	0.077	0.167	0.084	0.234**	0.260	0.000
PIU content is adapted to students' prior knowledge	−0.021	−0.031	0.734	−0.063	0.019	0.707
Problems are adapted for PBL	0.045	0.066	0.477	−0.089	−0.074	0.130
References are appropriate for the problems	−0.010	−0.036	0.680	−0.041	−0.006	0.895
Self-study time is sufficient	−0.004	0.020	0.826	−0.091	−0.041	0.330
R^2		0.061	0.245		0.068	0.000

This regression model tests whether the length of the reporting session is influenced by the length of the preceding tutorial session and by the position of PIU within the 2 year preclinical program (1–11), and depends on whether PIU content is adapted to students' prior knowledge, whether problems are suited to PBL and references suited to problems, and whether students do have enough self-study time. * $p \leq 0.01$; ** $p \leq 0.001$; [a] n = 147 tutors; [b] n = 719 students; [c] PIU order of sequence within the 2-year preclinical program

instructional unit within the 2-year program (model $p = 0.04$ for tutors and <0.001 for students). Regarding students' estimates of the length of the reporting session (Table 3), it was found that again it did not depend on the quality and appropriateness of the PBL problems, nor on the students' prior knowledge and appropriateness of the given references. It was however, dependent on the length of the tutorial session, on students' perception of having adequate self-learning time, and again on the position of the PIU within the 2-year program.

Conclusion and discussion

In this study we compared both students' and tutors' perceptions of their respective learning and tutoring practices within a 2-year basic medical sciences PBL-curriculum. While most studies investigated until now changes in PBL practices with the years of curriculum implementation (Moust et al. 2005; Neville and Norman 2007; Schmidt et al. 2011), our study focused on whether and how the practices may evolve within the curriculum itself and as the students progress from 1 year to another. Our results have revealed that some of the PBL instructional and learning practices and tutors' functions remain stable and conform to those originally intended, but some other evolve throughout the 2-year program and move away from the original intentions.

Similar to previous studies (Kaufman and Holmes 1996; Marsh and Roche 1997), our findings confirm that the tutors' and students' ratings can be convergent on some aspects of the curriculum and of the teaching, and divergent on others, and that their combined appreciations provide a more comprehensive and complementary assessment and perspective. While it was reassuring to observe that the content and problems selected for the preclinical curriculum in the earlier years of implementation were still considered well adapted to the students' prior knowledge and appropriate for the PBL learning process, the references, in contrast, were only considered as moderately appropriate by the students as well as the time available for self-directed study which was judged as not sufficient. Surprisingly, this was confirmed, although less severely, by those same tutors who choose, renew and adapt these references. Possible explanations for these observations can be derived from a recent internal survey (Gallay 2010) that investigated student's view on the curriculum. Students considered that the learning objectives were not sufficiently clear and consequently felt obliged to read all the proposed references, even when some of which were proposed as alternative readings on the same topic or concept. This resulted in an enormous amount of reading materials for some students and hence their perception of the lack of time for self-directed study. A study confirmed this finding (Lloyd-Jones and Hak 2004). It indicated that students "disconcerted by the lack of an explicit syllabus … based their learning upon the given resources for fear of omitting parts of the faculty agenda". To reduce this insecurity, students tended to rely upon the advices of past students on the choice of textbook which "indirectly determine (the) workload, standardized content knowledge…" and consequently reduced students' independence in their self-directed learning. This insecurity and dependence could be further attributed to students' needs of time to get acquainted and adapted to a student-oriented learning (Dochy et al. 2005), especially in their early years in an integrated PBL curriculum and most specifically the difficulty and time required to familiarize and develop one's self-directed learning (Loyens et al. 2006, 2008). The latter hypotheses are indirectly supported by our retrospective program evaluation survey (Vu and Germond 2011). It was found that an average of 78 % of the graduates (evaluation based on an average response rate of 36 % from seven classes) indicated at the end of their training that the program had provided them with sufficient time for self-directed learning. Finally, as stipulated by (Loyens et al. 2008), since both faculty and students share the same fear and uncertainty and since "in such cases, students are often provided with the core literature resources, which reassures faculty and tutors that the content will be covered", the development of self-directed learning may become a difficult and longer process to be acquired.

One of the main findings of this study concerns the actual length or duration of the tutorial and reporting sessions and how it changes over the course of students' progression in the 2-year preclinical curriculum. Overall, with the intended (and scheduled) 2 h for the

tutorial and reporting sessions, the tutorial sessions were considered by both students and tutors to be usually shorter than the reporting sessions and that over time, throughout the 2nd and third year program, they tended to get even shorter. In contrast, the reporting sessions got longer as they progressed during the course of the 2 years. Overall, it seems that the length of the tutorial and reporting sessions is not determined anymore as in the earlier time of PBL implementation by the quality and adequacy of the PBL unit content and problems (Dolmans et al. 1993). It seems that once these aspects have been improved and stabilized over the years of implementation, the length of the tutorial and reporting sessions vary largely in function of the timing of the units in the 2-year curriculum. In addition, the length of the reporting sessions was found to be independent of the appropriateness of the reading references and more dependent on the length of the preceding tutorials and students' perceptions of the time available for self-directed study. Again an internal survey of the students, (Gallay 2010) found that over the years, as they proceeded through the curriculum, students tended to shorten the tutorial brainstorming process necessary to derive their own needed learning objectives to the problem. They instead brought to the session the objectives defined by previous classes of students without deriving themselves the priority or importance of the objectives in explaining the problem. Consequently, in the reporting sessions, students tended to push for reviewing all the objectives irrespective of their importance in order to comfort their sense of insecurity described above. Faced with examinations which are still focusing more on knowledge details than higher reasoning, students would want to cover all the knowledge which they think may be covered on the exams.

A second possible explanation regarding the length of the PBL tutorial and reporting sessions is that students may revert over the years to a more expedient, superficial and hence less demanding approach to learning. This could be explained by the complexity and time-consuming learning activities required in PBL sessions (Groves 2005) and the difficulty and demands of the deep learning approach over the surface approach (Marton and Saljo 1997; Struyven et al. 2006; Gijbels et al. 2008).

A third possible explanation is that the length and quality of the PBL sessions may also be affected by the role and functioning of the tutors themselves (Dolmans et al. 2001; Van Berkel and Dolmans 2006; Chng et al. 2011), their approaches to teaching (Richardson 2005), and the specialty or in this case the organ system of unit of instruction they are involved in tutoring (Norton et al. 2005). Tutors' approaches to teaching are affected by their styles of thinking, personality and underlying conceptions of teaching (Richardson 2005). Given that students tend to adopt a less time-consuming learning approach and have difficulty to change to a deep learning one, tutors' attempts to bring students to best profit of the program design and to orient their teaching to the program objectives and deep learning can be quite challenging for them to carry out. The present findings and their likely interpretations imply that motivating and steering both faculty and students toward deep learning processes still remain great challenges since they require time, perseverance and pursuit to go beyond surface and superficial learning. With the increasing pressure and demands of medical training institutions on faculty in research, clinical practice and administrative activities, the needed dedication and additional efforts from the faculty to ensure students' deep learning may be a rare commodity.

While students' assessments and tutors' self-assessments indicated that the tutors know well the PBL teaching approach and are well prepared for their tutorials, they are however less regular in providing feedback to the students and in evaluating group functioning. In these evaluations, in contrast to the students, the tutors tended to underrate their own knowledge, preparedness, and regularity in providing personal feedback and instead to

overrate their regularity in discussing group functioning. Findings on discrepancies between perceptions of one's own competencies versus others and on tutors' ability and regularity in providing feedback have been in part confirmed by previous studies (Eva 2001; Eva et al. 2004; Eva and Regehr 2005; Baroffio et al. 2007). Overall, tutors tended to conduct less and less the evaluation of the group functioning over the 2-year program. This in turn influenced negatively the student's perceptions of getting feedback and also the tutors' perceptions to give feedback. For the students, these findings were further dependent on whether the tutors mastered the PBL approach and whether they were well prepared for the problem. As with the PBL learning and tutoring activities, the processes of providing students individual and group functioning feedback have often revealed to be a difficult process in itself (Hattie and Timperley 2007; Shute 2008) and challenging to practice by basic sciences tutors (Baroffio et al. 1999; Baroffio et al. 2007). The reason tutors' providing less feedback as the curriculum progressed from the second to the third year could result from the observation that the students and tutors were slowly engaging in more superficial learning and teaching. Furthermore, unless deeper learning is engaged by both students and tutors, the process of providing feedback by the tutors may not be easily achieved.

This study has several limitations. First it was conducted at a single institution and is a one-time study. While we were able to obtain and replicate the same trends of students' evaluations in the following academic years, the tutors' survey could only be carried out for 1 year since it is time-consuming for the teachers. However, this study might constitute a benchmark against which other schools could judge their own PBL situation. Second, the response rates of students were variable across the PIUs and in one case fairly low, but overall, for more than two-thirds of the PIUs, the response rates were higher than 70 %. Third, while the items chosen for the tutors' questionnaire were similar to those of the students' validated questionnaire, they have not been formally validated. Fourth, most of our studied variables are measured by a single item. Finally, while this study mainly relied on opinions and self-perceptions, there is a convergence of the ratings of a single cohort of students for several PIUs and of different groups of tutors for each PIU, hence suggesting to a certain extent the relevance and stability of the findings,.

In conclusion, the results suggest within the context of recent findings in educational research, that students' and teachers' respective changes in learning and tutorial practices do not simply result from the tutors' or students' fatigue with the learning approach but might be caused by several different factors. Namely, they could be the tutors' *and* students' own concepts of teaching and learning, the practice environment (e.g. student assessments, tutor and student workloads, instructional units), the arduous and complex acquisition of deep and self-directed learning and the complex interactions between these factors. These results raise the possible discrepancy between the so-called constructivist learning environment and the reality of practice that could stay far from what is intended. Our future studies aim at better understanding the learning environment provided to students and its interactions with personal factors such as students' learning approaches. In addition, as the appreciation of the program by students and tutors varies among PIUs, we intend to analyze whether student learning in a PBL setting might be influenced by the subject matter. Finally, we consider that this study has practical implications: we believe that restructuration and efforts in faculty development as well as in guiding student's conceptions of learning will be necessary to overcome students' difficulty in acquiring and maintaining in the long term a deep learning approach.

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