A structured PBL tutorial involving small teams for teaching the human nervous system

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Abstract

Background: The Human Nervous System and Behavior course at Harvard Medical School (HMS) incorporates a hybrid model of problem-based learning. Student preparation for and participation in the tutorial seemed to be insufficient.

Aims: We sought to increase student engagement in tutorial by creating a structured approach, which included assigned roles for students, weekly testing, formal cornerstone presentations, and a weekly self-assessment exercise. We wished to determine the students' and tutors' satisfaction with this structured approach as compared with the more traditional tutorial experienced in other courses at HMS.

Methods: For the first 4 years of the course, students ($n = 160$) were surveyed concerning their impressions of the quality of the structured approach in comparison with the traditional tutorial. In addition, they were surveyed concerning the cornerstone presentations and the self-assessment exercise. Tutors ($n = 10$) who had taught in both the traditional and structured tutorial formats were surveyed about their impressions of student performance as well as their own enjoyment in the structured format.

Results: Students and tutors found the structured approach superior to the previous method. Both groups noted increased student preparation, participation, and accountability. Tutors preferred teaching in the structured format.

Conclusions: The structured approach increased student accountability, preparation, and participation. Students and tutors preferred this tutorial experience over the previous approach.

Introduction

Harvard Medical School's (HMS) new pathway has been in place for approximately 25 years. The centerpiece for this approach is the problem-based learning (PBL) tutorial system in which students meet in small groups to learn the fundamentals of medicine through clinical cases and develop intellectual habits that will allow them to become life-long learners. In the traditional approach at HMS, the tutorial is an integral part of each pre-clinical course. Each course typically includes a variety of other learning experiences including lectures, laboratories, and clinics. During the tutorial, students meet several times a week to work through a paper case specifically designed to achieve a set of learning goals that have been designated by the course's leadership. The driving educational theory behind this approach has been amply discussed by Barrows (1983, 1986, 1998), Norman (1988, 1989, 2001, 2008), Norman and Schmidt (2000), and more recently by Aretz (2003) and by Taylor (Hamdy 2008). In addition, Dolmans et al. have provided important insights into the cognitive and motivational aspects of the tutorial. Using modern insights into learning, they have discussed key aspects of the learning process including constructivist, collaborative, self-directed, and contextual elements (Dolmans et al. 1998; Dolmans et al. 2005; Dolmans & Schmidt 2006).

There are a wide variety of PBL approaches (Norman & Schmidt 2000; Miflin 2004b; Taylor & Miflin 2008). In a recent review, Hung has organized these various approaches along the axes of self-directedness and problem structuredness (Hung 2011). In this respect, our tutorial system is a hybrid model. The basic design for the HMS tutorial consists of a group of 6–8 students meeting several times per week with a faculty tutor. Our tutors are all trained in some aspect of the neurosciences and as such would fall under the heading of 'content experts'. In addition, they have undergone considerable training in PBL process and many have tutored over several years to decades. In this respect, most of our tutors may be thought of as both content and process experts capable of providing subject matter expertise and effectively facilitating the learning process (Dolmans et al. 2002). The group comes together three times a week to work through a written clinical case consisting of multiple parts, which follow in sequence. As the students examine each part of the case, they identify the salient information and significant

Practice points

- Both students and tutors found that a structured approach to the tutorial was highly effective for learning the human nervous system.
- The structured approach led to a greater sense of individual accountability and a higher level of student preparation and participation.
- Students found it to be a more efficient use of their small group time.

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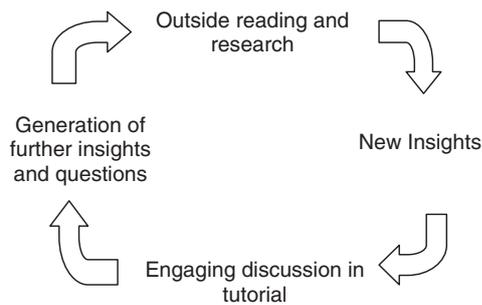
Figure 1.   Regenerative learning cycle in tutorial.

Figure 2.   The negative learning cycle in tutorial.

issues, draw upon each other's knowledge to explain the information, and identify the gaps in their knowledge necessary for a thorough understanding of the issues at hand. The group sets an agenda for outside study directed toward answering the questions, which have been generated and returns to the next session armed with the relevant information and prepared to move on to the next part of the case.

In essence, the case is designed to be a trigger, which stimulates student curiosity and creates the regenerative learning cycle illustrated in Figure 1. The issues raised in the case motivate an engaging discussion during the tutorial, which leads to the generation of additional questions and insights. Students leave the tutorial motivated to investigate the issues, which have been raised by the case. This generates a new round of discussion and the positive learning cycle continues (Figure 1). A key element of the learning cycle involves individual study on the part of the students. The new information, which is brought into the tutorial is an essential component of the fuel for new learning as has been described by several authors including van den Hurk et al. (1999).

In the years preceding the implementation of the tutorial system, leaders of the pre-clinical courses, especially in the latter part of the first year and throughout the second year, have had the strong impression that our tutorials have not been achieving their goals. We had the impression that we were experiencing dysfunctional, 'ritual' behavior resulting from a lack of in depth individual study, as has been discussed previously in the literature (Norman & Schmidt 1992; Hitchcock & Anderson 1997; Dolmans et al. 2001). Students did not seem to be highly motivated during the tutorial, and many had demonstrated inadequate preparation and limited exploration of the richness of the tutorial cases. Because of inadequate preparation, many students came to the tutorial with a limited knowledge base. This led to a rather superficial, often awkward discussion of the case in which few thoughtful questions or insights were generated.

It often seemed as though the students were merely 'going through the motions.' The students left the tutorial unmotivated to engage in significant additional research, perpetuating the negative feedback cycle shown in Figure 2 and which has been previously well described by Dolmans and Schmidt (2006).

In the Human Nervous System and Behavior Course (HNSB), given at the start of the second year, tutors were becoming demoralized by the lack of student enthusiasm for
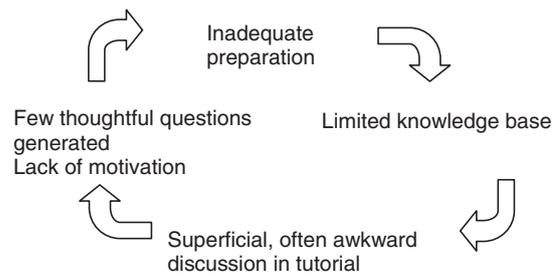
the tutorial. Tutors were happy to contribute their time in order to lead and inspire motivated students but were reluctant to serve in the role of disciplinarians pushing students to get their work done. The HNSB course leadership decided to develop a modified tutorial system. In doing so, we wished to maintain the positive motivational aspects of PBL by creating a student-directed solution rather than a teacher-directed solution, as has been discussed by Dolmans and Wolfhagen (Dolmans et al. 2001). The focus of our approach was to place greater emphasis on student preparation, accountability, and participation. In addition, we decided to place a major emphasis on teamwork within the tutorial as we believed this would be a valuable skill for the students to carry with them into the clinical years. The basic working ingredients of our approach were subdividing the tutorial into smaller working groups, advanced preparation of the initial parts of the case, student presentations of key concepts, and the use of test cases to reinforce learning. A very similar approach to the tutorial has been successfully adopted by Espey et al. at the University of New Mexico School of Medicine (UNM; Espey et al. 2007). We compare our findings with theirs in the 'Discussion' section. A portion of this work was presented earlier in abstract form(Cardozo & Raymond 2003).

Goals

The specific goals for the tutorial were to establish: (1) greater preparation on the part of the students; (2) increased individual responsibility and accountability through the establishment of task-oriented sub-teams; and (3) encourage greater student participation through sub-team reporting.

Design

The design for the new tutorial was developed by the HNSB planners, which consisted primarily of experienced tutors and a student representative who had completed HNSB the previous year. The plan was discussed with a student focus group consisting of approximately eight students currently in their first year, and who represented the first class that would use the new approach. The focus group was invaluable in providing insights into which aspects of the proposal would represent an effective developmental step up from first year and which features might prove to be too overwhelming. The tutorial design was modified as result of this information.

The design was quite simple. The HNSB course lasts for 7 weeks. The tutorial meets three times per week to work

Figure 3. The division of team responsibilities in tutorial.

through a single case. Each tutorial consists of seven students along with a tutor. The students are subdivided into three teams, each having unique responsibilities, with one student acting as case leader. The assignments are maintained throughout the week and students rotate through different positions each week. All of the students act as case leader at least once and serve on each of the teams multiple times (Figure 3).

The weekly objective for the tutorial is to analyze the case in a comprehensive and professional manner. The three teams are the clinical, research, and longitudinal teams, and the remaining member of the tutorial is the case leader. The case leader assists teams as needed. Each team is responsible for covering its domain of the case, with the goal of providing the necessary pieces to achieve a thorough analysis and understanding of the case. For instance, the clinical team researches and is responsible for clinical features of the case, such as diagnosis and treatment plan, whereas the longitudinal team is responsible for describing the course of the disease, epidemiology, preventative strategies, and its impact upon the patient's life. The research team covers research relevant to the disease including such aspects as animal models and human trials. The case leader ensures that all aspects of the case are covered by the group, summarizes the case, and leads the tutorial in its self-assessment. The assignment of responsibilities to each team is done in the spirit of accountability but not exclusivity. All members of the tutorial are free to explore and engage in any and all aspects of the case. The team approach ensures that each member is taking responsibility for some aspect of the case. The students organize their team assignments, and each week everyone is required to rotate to a different team. This permits each student to serve on all of the teams and act as case leader at least once during the course. Typically, each student rotates through each team assignment twice. The roles for the case leader and team members are shown in Table 1.

Additional aspects of the tutorial

In addition to assigning students to teams within the group, there are three additional aspects to the tutorial structure.

Table 1. The roles of the Tutorial Teams.	
Assignment	Duties
Case leader	Guides the development of the case by ensuring that each team provides the necessary information and ensures that tutorial as a whole is participating fully and balancing the necessary tasks.
	Sets the agenda with the group for each tutorial meeting of the week.
	Summarizes and reviews the case at the end of the week.
	Leads the self-assessment exercise (morbidity & mortality) for the group at the end of the week.
Clinical team	Leads in establishing a thorough and logical differential diagnosis based upon underlying anatomy and physiology.
	Interprets and explains all clinical data including exams, laboratory values, imaging, etc.
	Presents treatment options.
	Establishes a patient management plan based on the best current practice.
Research team	Covers experimental models and approaches relevant to the disease.
	Presents information on current clinical trials and their rationale.
	Suggests novel experimental approaches.
Longitudinal team	Presents the typical course of the disease including the psycho-social and economic impact upon the patient and family.
	Covers the epidemiology of the disease (socioeconomic, racial, gender, age strata, etc.).
	Discusses any ethnic/social disparities in access and treatment.
	Discusses preventive strategies.
	Discusses economics of treatment (optional).

Table 2. A typical week.	
Session	Activities
First	1. Review test case from previous week.
	2. Begin case work: clinical team takes the lead. Establish a differential diagnosis and engages tutorial members in working through the case. Tutorial should get to the point of establishing the correct diagnosis, so that the research and longitudinal teams can start their work.
	3. Set agenda for second session.
Second	1. Address agenda items.
	2. Clinical team: presents a treatment plan.
	3. Research team: presents the current status of research, clinical trials, etc.
	4. Longitudinal team: presents longitudinal, epidemiological, preventative aspects of case.
	5. Set agenda for third session.
Third	Address agenda items.
	1. Cornerstones
	2. Presentation of the concept map by case leader. Review of the key features of the case with integration of the relevant basic science concepts.
	3. M & M and development of an action plan.

They are: formal 'cornerstone' presentations by the students, a self-assessment exercise termed 'morbidity and mortality', and a weekly take-home test case. Table 2 provides an outline for a typical week.

Cornerstones

Each week, two students present a 20–30 minute review of a fundamental topic underlying the week's case. The topics are set by the course leadership, but they can be altered to suit the needs of the tutorial group. The goal of the exercise is two-fold. First, it ensures that the tutorial focuses on the essential topics. Second, it gives students an opportunity to practice giving a presentation in a supportive environment. Each student has two opportunities to give a presentation, one during the first half of the course and one during the second half.

Morbidity and mortality

Each tutorial ends with a discussion of how the group performed as a team and how it can improve. The goal is to improve the tutorials during the course and to provide the students with a critical professional skill, the ability to give and receive constructive performance evaluation. It is stressed that error is a normal part of professional activity, and the true professional freely acknowledges and accepts error as a part of life. The case leader canvasses the tutorial members for strengths and for areas needing improvement in reviewing the performance of the tutorial teams, the cornerstone presenters, the group as a whole, and the case leadership. The immediate goal of morbidity and mortality (M & M) is to have the tutorial reflect in a critical manner on how the week's case went and to identify areas of weakness. The long-term goal is to get the students to a point at which they feel comfortable acknowledging error and developing plans to correct it in the future. The M & M session ends with an action plan to identify areas for improvement and specific goals for the following week.

Test case

Each week, the students complete a take-home test case. Each student prepares the test case individually, provides written answers to the questions, and turns it in to the tutor. The test case presents a second disease, which is related to the case of the week and includes a series of questions concerning common principles involved in understanding the two cases. For instance, when the students are working through a tutorial case concerning a disease of the neuromuscular junction such as myasthenia gravis, the test case is on a different disease of the neuromuscular junction such as botulism. If the student has understood the week's tutorial case in sufficient depth, then the student is able to apply the principles learned in the tutorial to answer the questions raised in the test case. In addition, the presentation of the second disease serves as reinforcement for the week's work. The test case serves as a vehicle for consolidation of knowledge and allows the student to gauge whether his/her understanding is consistent with the expectations of the course. Upon completion of the test case, it is discussed in the tutorial providing further consolidation for the group.

Methods

Setting

The setting for the study was the HNSB course, which meets 5 days per week for 7 weeks. The tutorial groups meet for 2-hour sessions, three times per week.

Subjects

The students are members of the second-year class. There are usually 24 tutorial groups consisting of seven students and a tutor. The tutorial is led by an expert tutor in so much as he/she is trained in some aspect of the neurosciences, whether it is basic neurobiology, neurology, psychiatry, or neurosurgery. The majority of our tutors are experienced and have participated in the HNSB course over many years. Students were prepared for the new tutorial through a 1-hour orientation session. Tutors were prepared for the tutorial through an initial 2-hour orientation session and a weekly 1-hour feedback and discussion session throughout the course. Students and tutors were provided with a written blueprint describing the new tutorial (and its objectives) prior to the start of the course.

Instrument

The student perceptions concerning the new approach were obtained via anonymous end-of-course evaluations providing both numerical ratings and written feedback. The tutors' evaluation of their tutorial experience was provided by completing an anonymous survey. The tutors who participated in the survey were only those who were able to provide a meaningful comparison between the two approaches by having taught in both the old and new tutorial formats.

Procedure and analysis

For the first 4 years (2002–2005) that the new tutorial system was in effect, the HNSB students evaluated it in comparison with their previous tutorial experiences in their end-of-course evaluations. During this period, the class size ranged from 169 to 171 students. The response rates for the four years were: 98%, 98%, 89%, and 99%. The students provided numerical ratings using a Likert scale with '1' being the highest possible rating (excellent) and '5' the lowest (poor). Ratings were provided for the overall quality of the tutorial as well as for the cornerstone and M & M components. In addition, many students provided written commentary on their impressions of the new tutorial method. Although the individual responses were anonymous, the written responses could be linked to the numerical rating allowing us to group written responses with particular scores. After all comments were analyzed, only those comments that included explicit language, which could be unambiguously assigned to a group were tallied. As the results were so clear cut, a second rater was not deemed necessary (in this respect, the results of the responses should be considered impressions as opposed to data).

In addition, the impressions of 10 experienced tutors were surveyed. All tutors had taught for several years in both the

previous and the new tutorial approaches. They can all be considered expert tutors who had significant training and experience in facilitation of learning. They reported their impressions on the preparation, participation, and the overall performance of students in the new tutorial as opposed to the earlier approach. The tutors were also surveyed concerning their own enjoyment teaching in the new format when compared with its predecessor.

Results

We have examined the responses over 4 years of students taking the course (average class size: 170; response rate: 89–99%). The students responded very favorably to the new team approach to PBL. Figure 4 shows the results for the students' overall rating of the tutorial each year. The majority of the class rated it '2' or better and for the past 2 years of the survey, approximately 70% gave the tutorial the highest possible rating. Interestingly, ratings for the tutorial improved over the 4 years.

In their written comments, the students identified what they perceived as the strengths and weaknesses of the new approach. The vast majority of the comments were favorable, which is consistent with the numerical ratings. The main positive features, which students repeatedly commented on were:

(a) The team assignments gave them a heightened sense of individual responsibility and accountability.
(b) The structured approach led to greater participation as each member of the tutorial had specific tasks that came with his/her team assignment.
(c) The tutorial had more direction, was more focused, and more efficient with little duplication of effort.
(d) Students arrived more prepared than they had been in the more traditional approach.

Those students who did not rate the new tutorial highly consistently commented on the following features:

(a) The structured format was too rigid. It limited spontaneity, flexibility, exploration of individual areas of interest, and stifled the free flow of ideas.
(b) The style of the tutorial shifted from open discussion to a series of presentations.
(c) The workload involved in preparation was too great.

In addition to general rating and comments, the students reported on two specific features of the tutorial, the cornerstones and the M & M exercise. Each year, students scored the cornerstone exercise slightly higher than the tutorial overall with 75% of the students rating it as 'excellent' on the final survey (Figure 5).

The students who rated the cornerstone exercise as a '1' identified the following positive features:

(a) It reinforced and reviewed fundamental concepts.
(b) It gave the students the opportunity to develop teaching and presentation skills.
(c) Students enjoyed learning from their peers.

Students who rated the cornerstones poorly commented that they tended to be redundant with material presented in lecture or discussed in the tutorial.

In contrast with cornerstones, students were much less positive about the M & M component. As can be seen from Figure 6, although student responses were varied, only about 15% of students rated the exercise as 'excellent.'

Students who rated the exercise highly commented that it was effective for reminding students of their goals for the tutorial and provided opportunity for reflection. Students who gave it a poor rating commented that:

(a) It felt uncomfortable to criticize ones's peers.
(b) The exercise seemed repetitive and unnecessary.
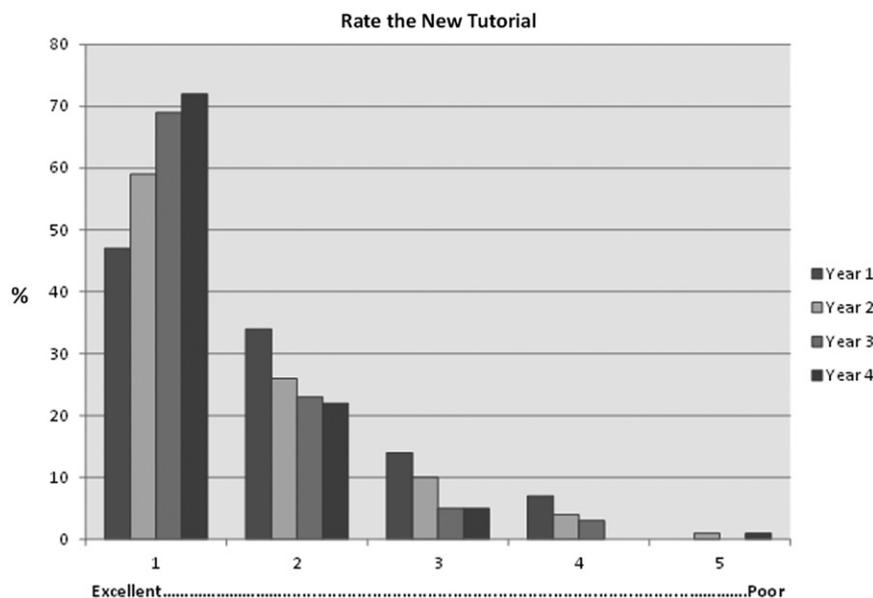(c) There was not sufficient time.

Figure 4. Overall rating of the new tutorial. Students were asked to rate the new tutorial from 1 (excellent) to 5 (poor).
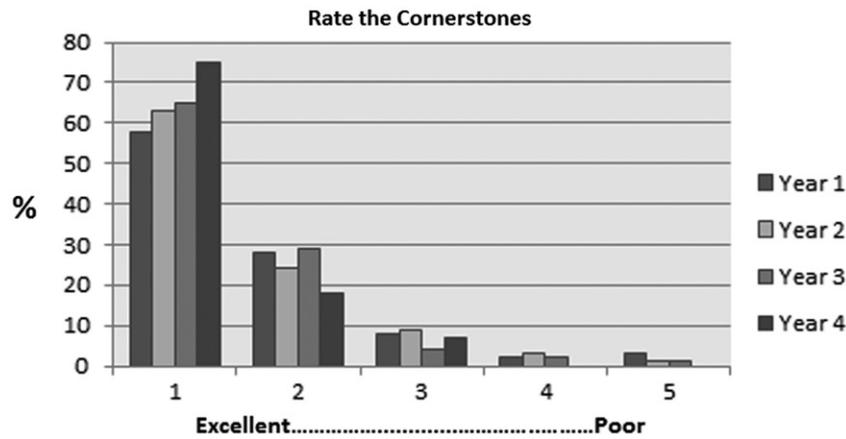
Rate the Cornerstones

Figure 5. Cornerstones rating. Students were asked to rate the cornerstones exercise from 1 (excellent) to 5 (poor).
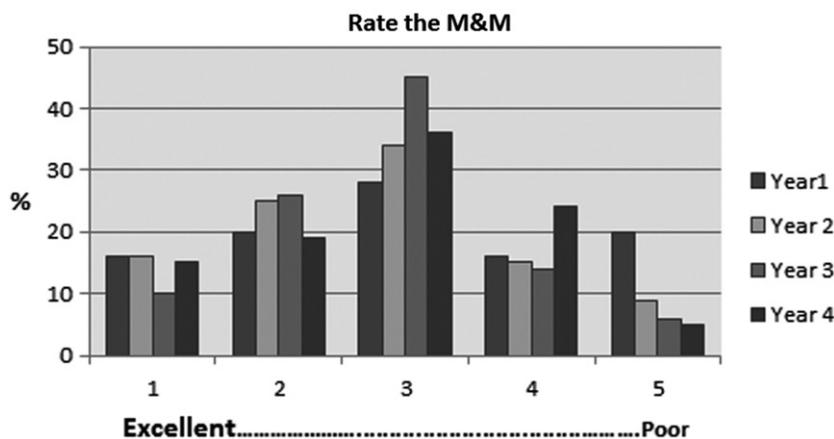
Rate the M&M

Figure 6. M & M rating. Students were asked to rate the morbidity and mortality exercise from 1 (excellent) to 5 (poor).

In addition to getting the students' views, we were also interested in obtaining the tutors' impressions of the new approach. Ten experienced tutors who had taught in the HNSB course using both the former and new tutorial formats were surveyed on their impressions of the new system in comparison with the traditional tutorial. In each case, they were asked to rate the new system in comparison with the traditional tutorial on a scale of 1–5, with '1' representing 'much superior' and '5' representing 'much inferior.' The results are shown in Figure 7. Tutors reported on student preparation for the tutorial, student participation during the tutorial, overall student performance, and how much they enjoyed teaching in the new system as opposed to the traditional tutorial. As can be seen from the graph, the tutors' overall responses were positive. They reported generally improved student performance across the three criteria examined and additionally, all tutors indicated that they enjoyed teaching in this format.

Discussion

It is our impression that this tutorial method has been successful. Students seem to have been very comfortable using a more structured approach. In feedback given to tutors

and to course directors, the students indicated that they found the system to be more efficient. They appreciated having defined goals and felt that they had a better understanding of what was expected of them. In addition, students reported that they experienced a greater level of participation due to the increased level of accountability. We often heard students report that they worked much harder in the new tutorial and felt they got more out of it. We did not survey the students as to which ingredients of the new approach were most critical, although in retrospect, this would have been most helpful. Our impression and the impression of our tutors is that the most important ingredients were the requirement for small groups to be accountable for and report on specific features of the case, the need for advanced preparation of the case, and the cornerstone reporting exercise. Although the test case served as a motivator for self-study and consolidator of the material, we do not believe it essential to the success of this approach. The M & M exercise, which is discussed in the subsequent sections, did not seem to be a generally successful element of the tutorial.

The difficulties that we had experienced in the previous tutorial system were similar to those that have been discussed in the literature (Hitchcock & Anderson 1997; Dolmans et al. 1998; Dolmans et al. 2005; Dolmans & Schmidt 2006;
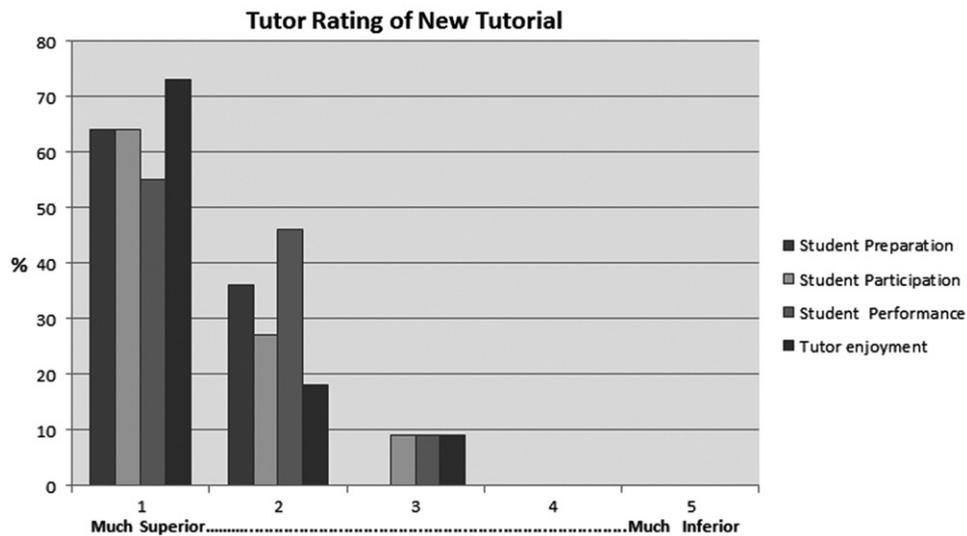
Figure 7. Tutors' experience in the new tutorial. Tutors were asked to rate aspects of tutorial shown above from 1 (much superior) to 5 (much inferior).

Espey et al. 2007). Our students seemed to be preparing insufficiently for their cases, which led to the previously described 'ritual behavior' and a spirit of apathy. As van den Hurk has discussed, strong preparation on the part of the students is essential for meaningful reporting and discussion during the tutorial (van den Hurk et al. 1999). It may be that this more structured approach has provided a necessary 'scaffolding' to direct the students toward more effective learning strategies. Wijnia et al. and Hung have recently discussed the advantages of creating a certain level of structure to the learning environment (Hung 2011; Wijnia et al. 2011). This study is consistent with the idea that a scaffolding emphasizing preparation, participation, and accountability and leads to greater satisfaction with the tutorial process.

Our tutors have clearly enjoyed teaching in this format. They found the students to be better prepared and more highly motivated. Interestingly, the emphasis on student preparation resulted in an unanticipated challenge. Students came to the tutorial with far more material than they had in the past. It was a challenge to find sufficient time to discuss all of the concepts and information, which were brought into the tutorial. Each tutorial group found itself developing time management skills in order to successfully cover the week's case. We suspect that the development of these skills will hold the students in good stead during the clinical years.

Although we have the strong impression that this approach represents a significant improvement in our PBL tutorials, the study has clear limitations. The tutorial is a complex learning environment with many variables in the students' experiences including the variability of individual tutors. The difficulty in making correlations between specific pedagogic approaches and learning outcomes has been discussed extensively e.g. (van den Hurk et al. 1999; Miflin 2004a; Hamdy 2008; Taylor & Miflin 2008). We have not demonstrated whether our changes will help students to better incorporate the fundamentals of neuroscience as applied to clinical medicine, let alone whether we have produced better learners or better doctors.

We are confident that the students and tutors enjoyed this approach to learning more than its predecessor and so we can say that we have achieved greater satisfaction.

Espey et al. at the UNM have used a similar approach for teaching a course on human sexuality and reproduction. The main difference between our two approaches is that we require significant preparation of the case in advance of the first tutorial (which they do not) and they include an exercise, which critiques research papers (which we do not). They also found it to be successful and reported that the both students and faculty observed better student preparation, increased team work, and participation, a higher depth of learning and greater engagement by the students (Espey et al. 2007). We were struck by how similar the experience reported at UNM was to what we have seen at HMS. The correspondence between what was observed at our two institutions ranged from the lack of preparation and perceived disengagement of students using the traditional tutorial, to the students' highly positive responses to cornerstones. We find this particularly interesting in so much as our two schools have different student populations and different emphases. UNM has a strong commitment to primary care medicine and to serving New Mexico's rural communities, whereas HMS has a greater emphasis on basic science research with a very high proportion of students going into medical specialties. Nevertheless, the experiences of the tutorial changes at the two institutions were virtually identical. Such a strong correspondence argues for the utility of applying outcomes at one medical school to programmatic initiatives at another. It may suggest that when considering pedagogical changes, the particulars of the institutional mission may not be a limiting factor.

The ratings of the tutorial improved over the four years. We suspect that two main factors were involved: first, the tutors became more skilled and more confident in leading the structured tutorial with subsequent offerings of the course. Second, students who had experienced the HNSB tutorial passed on favorable impressions to their lower classmen,

which lowered the barrier for acceptance of the structured approach.

Among the various features of the new method, the cornerstones have clearly been the most popular with the students (as was the experience at NMU). Students seem to have enjoyed preparing presentations for their tutorials and having produced a work product, which was specifically identified with the individual. At the weekly tutor meetings, the tutors consistently commented on the high quality and originality of the student presentations. In contrast to cornerstones, M & M was not particularly successful. Many students felt uncomfortable with the exercise. The most typical feedback centered on a reluctance to criticize fellow students. Members of the tutorial had difficulty embracing the idea that this form of analysis is not an exercise in personal judgment but is geared toward measuring outcomes against objectives. Perhaps M & M represents too great a leap from the more free-form approach of the unstructured tutorial. It may be that intermediate approaches will be required in order to acclimatize the students to thoroughly engaging in M & M's. For instance, teams might be asked to self-identify strengths and weaknesses in their own performance in one level of the tutorials and then be asked to identify the strongest point and weakest point of another team's performance in the next level of the tutorial, so that in a gradual manner, teams would rise to becoming completely comfortable with a full blown M & M exercise.

Two aspects of the team approach bear mentioning. As originally configured, each team contained two members, and the case leader was free to 'roam' among teams, helping out as needed. Our students evolved a culture of flexibility in terms of team assignments. They found that some cases carried a heavier load for a given team (often clinical) and would adjust the number of members assigned to each team accordingly. This seems to have worked out very well. A second concern we had with the team approach was that students would be reduced to becoming 'weekly specialists' depending upon their team assignments and would fail to integrate and consolidate the learning surrounding the entire case. Although a minority of students (<10%) raised these issues in the survey, the majority did not. Our tutors had the impression that in general, students were very much engaged in all of the teams' reporting and were probing for an understanding of all aspects of the case.

One surprising outcome of the structured approach has been the evolution of the case leader. As initially designed, the case leader was to be responsible for tracking the various teams' progress, summarizing the case, and leading the M & M exercise. Over the years in which the new tutorial has been offered, the students have become increasingly enthusiastic about the position. The position has taken on a more expansive role somewhat akin to that of an orchestra conductor. The case leader often requests the entire case in advance so that he/she can better assign team duties and typically leads the teams through the week in a highly proactive manner. Our tutors have unanimously viewed this as a positive development. We imagine it has resulted from the students' inclination toward positions of leadership. This reminds us that our structured design is only a blueprint

and that the ultimate form of the tutorial is shaped significantly by the culture of our students.

Conclusion

We believe that this structured approach to the tutorial has been successful. Its principal advantage has been to increase student accountability, preparation, and participation. There is a strong impression that more work gets done under this system. Certainly, the increased structure is not without cost. The tutorial is more formal and does not as easily lend to 'long pauses' and moments of spontaneity and creativity. It has the feel of a more 'business-like' experience. Nevertheless, it is our experience and the experience of our students and tutors, that the gains outweigh the losses. The approach, which we have implemented, may be of use at some but not all PBL institutions. Schools in which students and tutors are struggling with motivational issues may well benefit from a PBL tutorial structured along these lines. On the other hand, schools in which students are already functioning at high level of preparation and motivation, may find this approach too constraining.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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