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ABSTRACT

The learner's role in acquiring cognitive and interpersonal skills in a first-year medical school course in neurobiology (12 students) that used a small-group, problem-based teaching method. Objectives of the study were to: (1) determine the cognitive and interpersonal skills the students believed were important; (2) evaluate how well the students believed the course helped them acquire the skills they generated as well as the skills the instructor generated; (3) quantify students' beliefs about their individual learning styles; (4) determine if there are significant correlations between course evaluations and learning style beliefs; and (5) analyze the small group process to provide illuminating examples and identify the individual roles the students took during the group dynamics. Students who rated the course higher tended to describe themselves as more active learners who prefer to build concepts interactively, prefer to use intuition more than existing concrete models, and tend to re-evaluate their understandings of concepts continually. Students who rated the course lower tended to describe themselves as passive learners who prefer to model concepts in their heads, prefer to use existing concrete models to guide their thinking, and who are frustrated by discussions of concepts they feel they already understand. In the videotaped group sessions it was observed that students variously took the executive, recorder, contributor, critic/evaluator, and assimilator roles described by A. Brown and A. Palincsar (1989). "Clarifier" and "cheerleader" roles were also identified in this study. It is hoped that this information on the role of the learner in acquiring cognitive and interpersonal skills in small group, problem-based curricula will be of value for increasing the effectiveness of skill-oriented instruction. An appendix presents the outline for a learning workshop session.(Contains 3 tables and 10 references.) (SLD)

Individual Roles and Group Dynamics in a Problem-based Learning Classroom: Generating and Evaluating Skill-oriented Learning Objectives

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Individual roles and group dynamics in a problem-based learning classroom: Generating and evaluating skill-oriented learning objectives

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Abstract

Our research focused on the learner's role in acquiring cognitive and interpersonal skills in a first-year medical school course in neurobiology (12 students) that used a small group, problem-based teaching method. The objectives of this study were to

(a) determine the cognitive and interpersonal skills the students believed important for them to learn and practice in the course,
(b) evaluate how well the students believed the course helped them acquire the skills they generated as well as skills the instructor generated,
(c) quantify the students' beliefs about their individual learning styles,
(d) determine if there are significant correlations between course evaluations and learning style beliefs, and
(e) analyze the small group process to provide illuminating examples and identify the individual roles the students took during group dynamics.

Students who rated the course higher tended to describe themselves as more active learners who prefer to build concepts interactively, prefer to use intuition more than existing concrete models, and tend to continually re-evaluate their understanding of concepts. Students who rated the course lower tended to describe themselves as passive learners who prefer to model concepts in their heads, prefer to use existing concrete models to guide their thinking, and who are frustrated by discussions of concepts that they feel they already understand. In the videotaped group sessions we observed that students variously took Brown and Palincsar's executive, recorder, contributor, critic/evaluator, and assimilator roles. We also identified a "clarifier role" and a "cheerleader" role in our study. The importance of this research is to provide data on the role of the learner in acquiring cognitive and interpersonal skills in small group, problem-based curricula. We hope that such data would be of value for increasing the effectiveness of skill-oriented instruction.

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Introduction

In any classroom setting, there is an interplay of instructor, students, text and other materials, and activity (Figure 1). Three partly overlapping areas of research on the role of the student (Ng & Bereiter, 1995) focus on learners' (1) strategies, (2) beliefs about learning, and (3) goals. Within this paradigm, our research is focused primarily on students' beliefs about their own learning style, and how these beliefs might affect their performance in the classroom and how well they perceive the course accomplishes certain skill-oriented goals.

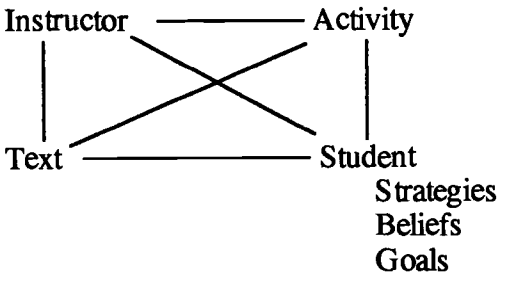

Figure 1. Components of classroom research.

Problem-based learning has many different implementations, but is generally characterized as learning relevant domain knowledge in the context of the skills and problems that characterize the domain (Boud & Feletti, 1991). In the case of medical school, this context can be defined broadly as "clinical competence" (Newble, van der Vleuten, & Norman, 1995). Newble, et al., include clinical reasoning, relevant knowledge, and relevant skills within the context of clinical competence (Figure 2). Relevant skills include interpersonal, clinical, and technical skills. They also state that each component is influenced by a range of attitudinal aspects which are difficult to define and more difficult to assess.

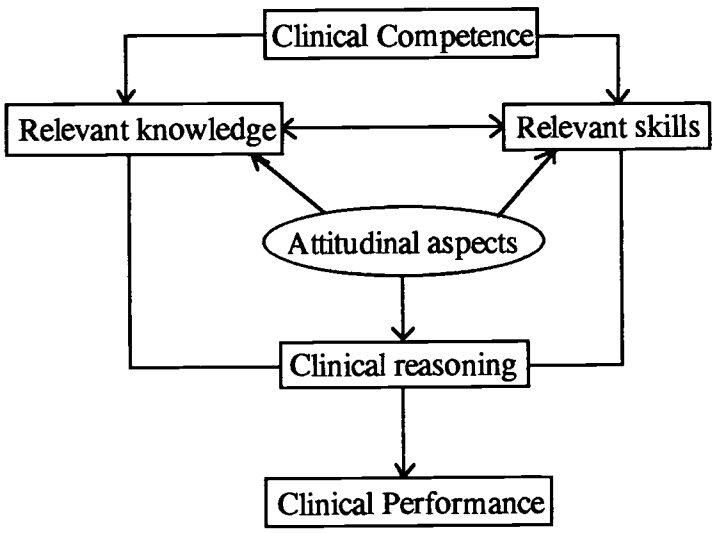

Figure 2. Components of clinical competence (Newble, et al., 1995)

In an attempt to define the "relevant skills" of expert clinicians, the Pew Health Professions Commission (1991) surveyed medical doctors, asking them to rate the importance of acquiring various skills during their medical school training (Table 1). The skills were broad in scope and

most received ratings of over fifty percent. These relevant clinical skills are rarely included as explicit learning objectives in medical school courses (so-called "undergraduate medical education"). This long list of broadly-defined, somewhat vague skills would seem daunting to teach, especially when considering the longer list of general scientific knowledge that must also be learned (cf. NMBE objectives). Explicitly teaching all of these skills could easily swallow up an entire medical curriculum. However, implicit in any teaching method are a set of skills that a student must employ in acquiring the required domain knowledge. Our research attempts to address the question: does making students aware of such implicit skills make their learning more efficient?

Table 1. Medical doctors indicating that it is "very important" for schools to provide formal training in the respective competencies.

Competency	% responding "very important"
Diagnose and treat disease	97
Communicate effectively with patients and families	92
Problem solving and independent thinking	88
Pursue a lifetime of continuous learning	83
Medical ethics	77
Foster wellness and encourage preventive behaviors	73
Involve patients/clients and their families as partners in health care	70
Manage large volumes of scientific information	62
Evaluate the appropriateness of complex and costly technology	62
Work effectively in teams with other health care professionals	56
Factor cost implications of treatment and care into decision-making	53
Assure access to good health care for all segments of society	50
Understand/respond to diverse needs and values of different cultures	47
Respond to the increasing role in and scrutiny of your work	43
Support community service agencies in meeting health needs	40
Understanding how to work in a managed care setting	14

To facilitate skill-learning and concept acquisition, the instructor could generate a set of skills (or "attitudes") that the curriculum could incorporate. The instructor's goals for the course would be some combination of skill and knowledge acquisition. Given that the intended goals of the instructor and the learning intentions of the student are often not the same (Resnick & Resnick, 1992; Ng & Bereiter, 1995) a dialogue between instructor and student is required in order to achieve maximum overlap between instructor's goals and student goals. It is necessary not only to explicitly communicate course goals, but also to provide a method for students' to evaluate their progress in meeting those goals.

Evaluation based on skill-acquisition is primarily metacognitive in nature (cf., Resnick, 1987; Brown & Palincsar, 1989). While metacognition remains a fuzzy concept, Brown and her colleagues (Brown, Brandsford, Ferrara, & Campione, 1983) divide metacognition into two clusters of activities: (1) knowledge about cognition and (2) metacognitive activities that are used to regulate and oversee learning. Brown et al. further claim that metacognitive knowledge is stable, statable, often fallible, and late-developing information. Metacognitive activities, such as planning, monitoring, and checking learning, are less stable because of their dependence on task and situation. Such dependency would also support the premise of learning in context that underlies problem-based learning. Periodically evaluating a course on a metacognitive basis may improve student and instructor awareness of such cognitive activities rendering them more stable within a

course's duration. Not all learners may achieve the skills and knowledge to the same degree in a given teaching method because instructors have differing, non-discrete sets of learning goals for their students. Thus, evaluations of a course may vary between students because of individual learning style characteristics.

The main context of the problem-based learning classroom is cooperative learning in small groups. Cohen (1994) reviewed much of the research related to productive small groups with students in K-12 classrooms. A common theme of the results is that the type of interaction that is most effective depends on the nature of the task and the instructional objective. For example, in conceptual learning, effective interaction should be more of a mutual exchange process in which ideas, hypotheses, strategies and speculations are shared in a supportive setting. This type of group interaction is similar to the explicit approach used in reciprocal teaching (Brown & Palincsar, 1989). The roles of the learner used in small group reciprocal teaching include executive, recorder, contributor, critic/evaluator, and assimilator. These roles correspond to many of the characterizations of metacognition. By explicitly having students take these roles in reciprocal teaching, the students less skilled in metacognition have been shown to become more metacognitive. We believe that by simply making students and instructors aware of the metacognitive features of their classroom one may improve the effectiveness of the teaching method used.

In summary, our research objectives of this study were to examine the interplay of student beliefs and goals in a small-group, problem-based learning classroom. Specifically, we sought to

(a) determine the cognitive and interpersonal skills the students believed important for them to learn and practice in the course,
(b) evaluate how well the students believed the course helped them acquire the skills they generated as well as skills the instructor generated,
(c) quantify the students' beliefs about their individual learning styles,
(d) determine if there are significant correlations between course evaluations and learning style beliefs, and
(e) analyze the small group process to provide illuminating examples and identify the individual roles the students took during group dynamics.

Method

Participants and classroom structure

We worked with the first-year class (12 students) of the University of California at Berkeley/University of California at San Francisco Joint Medical Program to establish and evaluate skill-oriented learning objectives (SOLO) for a small-group, problem-based neurobiology class. The semester in which we performed our research was the second semester that the students had participated in a small-group, problem-based course.

The structure of course divided the main topics of neurobiology into paper problems. The students were divided into two groups of six, and each group had a tutor (clinical physician). Each problem was divided into two sessions. In the first session, the students generated hypotheses about possible causes for the patient's problems, and they also generated six learning issues. A learning issue is some concept in neurobiology that the group decided they needed further information to understand, particularly in solving the paper case. In the second session, a week later, the learning issues are discussed, and there is an attempt to arrive at a diagnosis of the patient's problem. Also, at the beginning of each session is a "check-in" when each the students gives a brief statement of how they are doing in school, how they are feeling, how interesting they found the learning issues, and the like. At the end of the session, students divide up the learning

issues from the second session, choosing one each to review and write-up formally. There is a "check-out" when the students generally say how well they thought the session went, suggest any improvements in the group process, and the like. At the end of each session, we also had the students fill out a short session-evaluation form.

Skill-oriented learning objectives (SOLO)

At the beginning of the semester, we facilitated a session with the students during which they arrived at a list of cognitive and interpersonal skill objectives that they wanted to develop over the course (see Appendix 1 for workshop form, and Table 2 in Results). Independently, the instructors of the course also developed a list of skill objectives for the class based on the same questions (Table 3 in Results). These skills were compiled into a master list composed of both sets of objectives and were distributed to students and instructors for reference during the term.

Student evaluations of course success

At mid-term the students evaluated the course's success in helping them meet the instructor-generated and student-generated SOLO. The evaluation used a five-point, Likert scale ranging from "Not at all" to "Very much" to measure fulfillment of learning objectives. Open comments were also collected from the students regarding their global assessment of the course's structure and success. Students' qualitative and quantitative feedback was transcribed into an anonymous master list and given to the instructors to inform changes in the course's design at mid-term. The main change was increasing the time allocated to the second session (when learning issues were discussed) and reducing the time of the first session. Copies of these results were also distributed to students for their review. At the end of the semester, the students again evaluated the course. The data was compiled and presented anonymously to both instructors and students.

Learning style inventory

In addition to the end-of-semester evaluation, the students completed a learning characteristic inventory composed of fifteen bipolar scales (see Results for the scales and response frequencies) adapted from Kolb's learning skills inventory (1981). The bipolar scales were converted into a numerical scale from 1 to 7 for the purposes of statistical analysis; the number 1 was arbitrarily assigned to the left handed pole and 7 to the right. Blinded alpha-numeric codes were assigned to all papers, permitting us to correlate individual learning styles with the mid-term and end-of-semester evaluations of the course's success or failure in meeting the skill-oriented objectives.

Taping of group sessions

We also videotaped and audiotaped all of the group sessions, which totaled about 60 hours. The primary purpose of the taping was to have a record of the group interactions, in order to analyze individual roles and group interactions. Coding of approximately two hours over different sessions and with different groups was performed to see if the individuals were taking roles identified by Brown and Palincsar (1989).

Results

Student- and instructor-generated SOLO

Table 2 reports the results of the facilitated session at which the students generated their SOLO. As part of the activity in generating the SOLO, the students listed the activities that would

provide opportunities for obtaining or improving the skills. Table 2 also reports their mean evaluations at midterm and at the end of the semester.

Table 2. Student -generated SOLO and evaluations (1= "not at all, 5 = "very much").

Student-generated SOLO	Activity for obtaining or improving skill	Mean mid-term rating (SD)	Mean end-of-term rating (SD)
Communication: to listen to others and express oneself well; to learn teaching skills	In-class process	4.3 (0.78)	4.2 (0.45)
Handling information/database management: to be able to access resources (i.e. medical journals) well	Journals, out-of-class preparation	2.8 (0.83)	2.7 (0.98)
To be able to cope emotionally and respectfully with physical and mental boundaries; to be respectful of others and be responsible for one's own feelings	In-class process	4.2 (0.72)	4.3 (0.49)
To be aware of one's own knowledge; to be able to admit when one is wrong	In-class process, journals, out-of-class preparation	4.3 (0.65)	4.4 (0.67)
To be able to meet work goals	In-class process, journals, out-of-class preparation	3.9 (1.0)	4.2 (0.58)
To be able to manage time efficiently	In-class process, out-of-class preparation	3.5 (1.0)	4.0 (0.85)
To be able to problem-solve well	In-class process, out-of-class preparation	3.8 (1.0)	4.0 (0.95)
To be able to laugh	In-class process	4.6 (0.67)	4.7 (0.49)
To learn writing skills	Journals, out-of-class preparation	3.8 (1.1)	3.9 (0.90)
To be able and willing to see variables that are not medical that impact people's lives	<not assigned>	3.2 (0.94)	3.3 (0.98)
To be able to follow the group's goals	In-class process	3.8 (0.75)	4.1 (0.29)
To be empathic	In-class process	3.8 (0.72)	4.0 (0.43)
To have/portray a warm composure	In-class process	3.8 (0.87)	3.9 (0.57)
To be patient	In-class process	3.8 (0.72)	3.7 (0.78)

The instructor-generated SOLO and the students' evaluation of them at midterm and at the end of the semester are found in Table 3.

Table 3. Instructor-generated SOLO and student evaluations (1= "not at all, 5 = "very much").

Instructor-generated SOLO	Mean mid-term rating (SD)	Mean end-of-semester rating (SD)
Present knowledge in the context of specific Neurobiological problems	3.9 (1.0)	4.1 (0.90)
Use class meeting time to increase the perceived informational needs in a given area of Neurobiology	3.5 (1.0)	4.1 (0.67)
Have mutual respect with an understanding of how diversity of learning styles, etc. contributes to being a good doctor	3.9 (1.1)	4.2 (0.58)
Use self-directed study and information resources to meet the perceived needs raised in class	3.7 (0.89)	3.7 (0.89)
Set learning goals and evaluate progress towards those goals	3.6 (1.0)	4.2 (0.75)
Improve leadership skills in group work	4.3 (0.75)	4.3 (0.49)
Learn how to communicate complex concepts in simplified terms	3.8 (0.75)	4.1 (0.79)
Integrate knowledge into concise, understandable formats	3.5 (0.80)	4.2 (0.58)
Improve ability to build consensus and give peer review	4.2 (0.56)	4.2 (0.62)

On a Likert scale of 1 to 5, the student mean evaluation of how well all objectives were met at mid-term ranged from 2.8 to 4.6 with a mean of 3.8 (SD = 0.53), and at the end-of-term they ranged from 2.7 to 4.7 with a mean of 4.0 (SD = 0.37). Four of the individual SOLO increased more than 0.5, while none decreased more than 0.1. For the instructor-generated SOLO, the mid-term mean was 3.7 (SD = 0.52) and for the end-of-semester the mean was 4.1 (SD = 0.34). The difference was significant ($t = 2.8$, $p < .02$).

At the end-of-term evaluation, students also rated how well they believed the instructor-generated objectives and their objectives helped them in guiding their learning. On the 1-5 Likert scale, the mean for the instructor-generated objectives was 3.3 (SD=0.98) and for the student-generated objectives the mean was 4.0 (SD=0.95). The difference was significant ($t = 4.69$, $p < .001$)

Learning style responses

The frequencies of the students' self-reported learning styles are listed below.

1. Situations in which I learn best tend to be:

Active (i.e. engaged in a task)				Passive (i.e. listening to presentation)		
Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
5	2	3	1	1		

2. I learn best when

My teacher solves my problem				When I solve my problem		
Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely

				2	9	1

3. If a question arises when learning a concept in class, I prefer to:

Trust a hunch in order to continue — **Answer the question before continuing**

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
1	3		2	3	3	

4. When I learn, I tend to:

Have strong feelings/emotions — **Be quiet and reserved**

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
1	7	2	1	1		

5. When I learn, I tend to:

Listen/watch carefully — **Talk/steer the group's learning**

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
	3	1	1	1	6	

6. I learn best when I:

Model concepts in my head — **Build a concept interactively**

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
1	2	2	4	2	1	

7. When I learn a topic:

I like to approach it from many angles at the same time — **I like to work along a single line of thought at a time**

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
	4	3	2	1	2	

8. When learning a concept, I tend to:

Use my intuition to guide my thinking — **Use an existing, concrete model to guide my thinking**

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
	3	3	1	4	1	

9. When learning in a group, I learn mainly from:

Observing/listening to others — **Talking with others**

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
		1	2	3	5	1

10. I learn best from:

Rational theorizing — **Using concepts in a "real world" situation**

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
	3		1	2	5	1

11. When working with others in a group, I tend to:

"Jump in" with ideas as they come to mind — **"Hold back" and formulate ideas before stating them**

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
2	3	3	1	2	1	

12. I am most happy with a class when I leave:

Having thought about/discussed several concepts generally — **Having a deep understanding of a single concept**

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
2	1	1	3	2	3	

13. I tend to spend my time outside of classes:

Reading about the topic of the next class					**Reading about the previous topic to "fill in" the gaps from last class**	
Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
3	5	2			2	

14. A discussion is most productive for me when the group:

Answers specific questions about a topic that came up when studying					**Raises questions about a topic for study outside of class**	
Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
3	5	2	2			

15. Hearing other people discuss a topic in class that I already understand:

Frustrates me because I already understand it and would rather go on					**Engages me because I can re-evaluate my understanding of the topic**	
Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
	2	1		3	2	3

Correlations between SOLO evaluations and learning style responses

For the purposes of analysis, the students' mean evaluation of the course's success in meeting the SOLO at the end of the term were used. Pearson r correlations were determined for the mean evaluations and the students' ratings of their learning characteristics. Results showed that four of the bipolar scales significantly correlated with the student evaluations. The statistically significant results are summarized below:

- Students who rated the course higher tended to describe themselves as more **active learners** (#1), while students who rated the course lower tend to describe themselves as passive learners ($r = -.78$, $p < .01$).
- Students who rated the course higher tended to prefer to **build concepts interactively** (#6), while students who rated the course lower tended to prefer to model concepts in their heads ($r = .75$, $p < .01$).
- Students who rated the course higher tended to prefer to **use intuition** (#8) to guide their thinking, while students who rated the course lower tended to prefer to use existing concrete models to guide their thinking ($r = -.65$, $p < .05$).
- Students who rated the course higher tended to continually **re-evaluate their understanding** (#15) of concepts, while students who rated the course lower tend to be frustrated by discussions of concepts that they feel they already understand ($r = .74$, $p < .01$).

Individual roles and group dynamics

Several sections of the video transcripts were coded. The initial categories of coding were executive, recorder, contributor, critic/evaluator, and assimilator (Brown & Palincsar, 1989). We found two additional categories to be of value: a clarifier role, and a "cheerleader role." Each of the categories is listed below along with a brief description:

- **Executive** (directs learning toward an established goal)
- **Recorder** (keeps track of information for the group)
- **Contributor** (offers ideas and concepts, or poses questions)
- **Clarifier** (seeks to have ideas and concepts more clearly explained)
- **Critic/Evaluator** (compares or contrasts ideas)
- **Assimilator** (links ideas, suggests compromises)
- **"Cheerleader"** (offers support, encouragement)

The following is a brief excerpt of the coding:

C: It seems like he fell on his leg and some pathway that was maybe going from his brain down to his motor neurons was disrupted. Maybe the pathway was disrupted.	Contributor
T: GABA's all up there? (Laughter) Oh my.	Contributor/ "Cheerleader"
L: So is that a factoid?	Clarifier
A: Is that a hypothesis or a factoid? Maybe you should elaborate.	Clarifier
L: Maybe I should write it down somewhere.	Recorder
O: What did you mean, T?	Clarifier
T: Why, I don't know if the GABA sends tracts, inhibits tracts that go all the way down the spine and, it's just that since glycine inhibition is mostly in the spine , GABA's inhibition through tracts somehow?	Contributor
L: I was thinking about this thing, if you had trauma to your neck, how could you just selectively pick off you inhibitory tracts?	Critic/Evaluator

Discussion

To varying degrees we achieved our research objectives (*a* through *e*, as summarized at the end of the Introduction). We determined the skills the students believed important for them to learn and practice in the course through a facilitated group session. The group came up with several SOLO, many of which corresponded to the instructor's SOLO. The students arrived at more group process and interpersonal goals, possibly because they were focused on their own abilities to work together. The instructor's SOLO had more emphasis on the relation of knowledge and how it would be learned and used.

Through a questionnaire we evaluated how well the students believed the course helped them acquire the skills they identified as well as skills the instructor identified. The evaluation ratings did improve from mid-term and end-of-semester, particularly for the instructor-generated SOLO. This improvement could be the result of changes made in the course structure at mid-term. Also, it may have been easier for the students to see the purpose of the instructor's SOLO after the entire term had been completed. It could also be evidence of the students' goals moving closer to the instructor's goals.

We quantified the students' beliefs about their individual learning styles and determined that four of the bipolar scale had significant correlations between course evaluations and learning style beliefs. Three particular scales that showed significance seem to be closely related to the group process (learning actively and interactively, and discussing concepts when they were already understood). The fourth could also be related to small group learning in that learning by intuition versus through concrete models is see more as learning on the fly. Concrete models could be seen as an impediment to more fluid group process conceptual learning.

Kolb (1981) believed medical school learners were toward the center of his diverger-converger and assimilator-accomodator axes, hypothesizing that they would tend to be more centralists than outliers. Hence he thought them to be the best of all worlds. However, our data do not concur with this idea. Many students chose one extreme or the other. A fair number are in the undecided area, but the students show polarity in their characteristics and show different responses to a teaching method that tends to support all four steps of learning (i.e. diverging, assimilating, converging, and accomodating). That certain learning characteristics correlated with more positive reviews of the course may be indicative of an unrecognized emphasis in small group learning on a subset of Kolb's steps of learning that creates a learning environment favoring a subset of learners.

By coding videotape interactions we analyzed the small group process to provide illuminating examples and identify the individual roles the students took during group dynamics. For several places in the course, we were able to code the individual roles based on Brown and Palincsar's (1989) individual roles of the learners, as well as the two we also identified. All of the roles could be seen as metacognitive in nature. And it would be expected that medical students would be highly successful in metacognitive skills already.

In sum, our research provides some insight into students' beliefs of their learning styles, and their goals in a small-group, problem-based classroom. We have shown that not all of our students found this type of curriculum to be successful in skill-oriented learning, and we showed that these students may have different learning styles than those who thought the course to be more successful. We also believe that a coding scheme based on the roles of the learner is appropriate for coding individual roles and group dynamics in this setting. Future research will be necessary to investigate the relationship between individual roles and group dynamics, in both conceptual learning and skill acquisition. Insuring that small group, problem-based learning will go as smoothly and efficiently as possible for the students and instructors is the goal of such research.

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Appendix 1

Neurobiology Learning Workshop -- Session #1

Learning Objectives for Session:
1. To develop an explicit understanding of the skills essential to one's concept of an ideal physician.
2. To create learning objectives for the Neurobiology class that target some/all of the identified skills.
3. To incorporate these skill-oriented learning objectives into the current forms of assessment of the Neurobiology class.
4. To understand how the in-class cooperative learning process can be seen as a model of the individual problem-solving process.

A. What are the CHARACTERISTICS of an ideal physician? (Objective 1)

B. What SKILLS do each of these characteristics require on the part of that ideal physician? (Objective 1)

C. Think about the Neurobiology classroom. Go back to the skills list and circle the skills that Neurobiology class can help you to obtain/improve. (Objective 2)

D. Now try to prioritize the circled skills by grading them "1" for the most important/relevant skills to develop using the Neurobiology class, "2" for intermediate skills, and "3" for the least relevant skills. (Objective 2)

E. How can you use the following forms of assessment in the Neurobiology class to work on these skills? (Objective 3)
- "Journals" of learning issues (with paired peer review)
- Out-of-class preparation for the classroom
- In-class process of group-problem solving

What other activities could you add to the above list of assessments that would address the skills not already covered? These may be added to your contract as additional forms of *personal* assessment. (Objective 3)

F. Roles in Cooperative Learning (Brown & Palincsar, 1989):
1. Contributor - offers ideas/concepts to the group
2. Executive - directs learning towards an established goal
3. Critic/Evaluator - compares/contrasts ideas in pursuit of established goal
4. Assimilator - links ideas or concepts in forming a more integrated picture of problem/solution
5. Recorder - keeps track of ideas/concepts and learning issues raised during problem solving session

What TARGETED SKILLS are subsumed by these roles?
Are these "roles" necessary components of successful individual problem-solving? (Objective 4)

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