Conveying Instructor Expectations in a Project-centered Course

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Abstract

Instructor expectations of student behaviors in a teacher-centered course are different from the instructor expectations in a student-centered course. Many students successful in traditional lecture-based courses are frustrated and anxious when working on open-ended projects because they don't understand what is expected of them. Faculty teaching courses with open-ended projects may be equally frustrated that their students do not seem to be correctly perceiving their expectations despite their repetitive efforts to convey these expectations. This study used both quantitative and qualitative methods to understand both sides - the instructor's expectations of students and the students' perceptions of the instructor's expectations -in an open-ended, student-centered classroom. Four students and the instructor were interviewed throughout an upper-division undergraduate mechanical engineering course. This paper describes the research methods and preliminary results from this study. With the increasing integration of project-centered practices in the engineering classroom, the results of this study are anticipated to be beneficial to other instructors who are trying to transition students from the well-defined expectations of many teacher-centered classrooms to the open-ended expectations of a project-centered environment.

Introduction

When I was a sophomore taking engineering physics, the following equations were carved into my desk:

Engineering = Physics + Common Sense
Physics = Engineering – Common Sense

While I'll avoid comment on the second equation, I believe the first equation describes the challenge of contemporary undergraduate engineering education. Engineering students must learn the necessary scientific content that supports their chosen discipline. But in order to effectively and successfully perform as engineers, students need to graduate with some "common sense" when it comes to applying the scientific content they have studied. But how do engineering educators develop this necessary common sense in their students? Since the 1970's, capstone

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engineering design courses, where students are provided the opportunity to practice using their common sense as they apply physical principles towards real-world design applications, have become an accepted part of many engineering programs. But why wait until their senior year to begin exposing students to real world applications? At The University of Texas at Austin, Project PROCEED is encouraging the "trickle down" of real-world application projects through the mechanical engineering curriculum. Real world applications are being integrated into the curriculum beginning in the freshman year.

Instructor Expectations and Shifting Pedagogies

Engineering education is going through a shift from traditional teacher-centered lecture-based courses to more student-centered pedagogies such as project-based learning. But different pedagogies mean different roles for both instructors and students. Students may be caught in the middle of this shift. Too frequently students have been ingrained in a lecture-based system that rewards them for arriving at the right answer. In the traditional, lecture-based engineering classroom students frequently learn that success comes from attending class, taking notes, and solving the assigned homework problems. This is what the instructor expects them to do to be successful in the course. To prepare for tests they practice working problems - sometimes to the point of memorization - because success depends upon being able to solve problems on the test. These problems may be similar or even identical to the homework they have done or that the instructor has worked on the board. One student described her opinion of cramming for such courses.

> *I can cram like nothing else. But seriously, a week later, that's why I can't remember any thermo or fluids equations because I crammed. I even do study along as I go but there's always the night before the test, where I do all of the really memorizing which I think is horrible. You should really learn it. Keep it in your mind by learning it, not by memorizing it. I hate cramming.*

Many successful students are more successful at anticipating and meeting their instructors' expectations than meaningfully learning the material. One student described her success strategies through cramming: One student described how he approaches a new class:

> *I think that when you go to class, you look at the professor, you look at the syllabus, you look at the whole situation. The first couple of weeks, you don't know what's happening. You probably work more the first couple of weeks. You're more excited. And then you figure out the system.*

But in a student-centered, project-based classroom, there may not be lectures, textbooks, or problems to solve. The old strategies for success may not be applicable. So what do students do? They can try to determine what the new strategies are for success or they can keep trying to use their old strategies. To determine what defines classroom success now they must understand what learning behaviors the instructor expects from them. Students may have to respond to a whole

new set of instructor expectations which may not even be explicitly defined. In the student-centered classroom, students are now expected to assume many of the responsibilities for their learning. Students are expected to decide what to do and how to do it. But isn't this what they'll be expected to do as engineers after graduation? The same student who downplayed the benefits of cramming above described her positive learning experiences with this course:

> *But then this is so different. I have to read the book. ...I've already been big on self-learning and I've come to feel that this class is a lot of self-learning. So I enjoy it. I think I'm learning more, I think I'm learning a lot more than I would in a regular lecture format. I'm not sure that the stuff I'm learning is ever going to be useful to me but I'm definitely learning more."*

Description of Study

This exploratory study sought to define a better understanding of both how the instructor was conveying his expectations of the students and how the students were perceiving his expectations. Ideally there will not be a gap between the two but unfortunately students don't always understand what the instructor expects of them. The results of this study were anticipated to be useful in minimizing the gap between these two perspectives. The course of this study was an upper level course in which students tackled a complex project intended to provide them with the learning opportunities to synthesize together thermodynamics and fluid dynamics. Just as the real-world engineering problems they will encounter after graduation do not neatly confine themselves to the boundaries of any one course, the projects in this course required that students refer back to textbooks from several of their prior courses. But their old textbooks were not enough. They also had to reference other resources including library books and the Internet to gain more knowledge about the subject.

The professor for the section of the course I observed, who I will refer to as Dr. Austin, teaches this course using very open-ended projects with no one right answer that everyone should achieve through the one correct process solution. This lack of a single correct solution creates anxiety and frustration for some of his students who seem to desperately want an answer they can verify in the back of the book while others seem to thrive. But Dr. Austin is trying to expose his students to what the real world of engineering will be like for them. Real-world problems will be complex and require research to increase understanding of the subject. Complex problems require making assumptions that lead to different results depending upon the assumptions made. Not everything will be neatly defined. There will not necessarily be one right answer. Determining a solution may be an iterative process. He wants them to, and encourages them to, use their common sense while experiencing the process of attacking a complex problem. Dr. Austin emphasizes to his students that what he cares about is the process, not numbers or right answers. He also focuses upon effort, because "*I personally feel that the majority of the students learn from the effort even though they didn't exactly get it right in the end. They learned something from the process."*

Data Gathering.

The study used both quantitative and qualitative data gathering methods. Qualitative data was gathered through interviews, focus groups, classroom observations and surveys during the Fall semester, 2002. I interviewed the instructor weekly, observed the classroom sessions, and interviewed four students throughout the course. When choosing these four students I tried to pick a diverse sampling. Two of the students were male, two female. Two of the students were born and educated in the United States, two weren't. Three of the students had co-op or intern experience. One had no work experience. One was married and had a young child. All four had GPA's over 3.0. All four were active participants in the class to varying degrees.

Quantitative data was gathered through three surveys given to the entire class. The first survey I refer to as the screening survey. This was given very early in the course to gather data about students' attitudes towards projects and also to collect data about other student characteristics for selecting the four students to interview. The second survey was given mid-semester to record student understanding of the instructor's expectations for the final project. The third survey was given the last day of class. It again asked about the student's understanding of the instructor's expectations for the final project as well as a few items about student attitudes that related back to the first screening survey.

Classroom Environment.

The class, which met twice a week, was composed of 36 mechanical engineering students, all juniors and seniors. While this course was intended as a junior level course to be taken prior to the capstone senior design courses, over half the class was also taking one of the two capstone senior design courses resulting in a demanding course load for these students. The course was taught in a conventional classroom with students sitting at tables, not in a lecture hall. The room was crowded but this seemed to contribute to a degree of intimacy. This section, when compared to three others I had observed, was much more talkative, particularly the students on the "windows" side of the room. Many of these students worked together in the computer lab before class and seemed to have a sense of camaraderie. The instructor described his vision for his classroom:

> "*I have a very clear, in my own mind at least, vision of what I would like to see happen in the classroom… to have the students come in and be inquisitive and be willing to take some risks and to really pursue the knowledge rather than being little cups sitting there waiting to be filled so that they can pour it out on the test so that they can walk away empty and ready for the next class. But I really want them to demonstrate some initiative, some curiosity, some involvement, some desire to learn and understand things, not just answer questions.*"

Initial Communication of Instructor Expectations.

The instructor, Dr. Austin, stressed his expectations of the students the first day of class, both

orally and through text. The instructor told the students, "*I will not lecture. No lecture. We will have lots and lots of discussion. My purpose for being here is to encourage, sometimes cajole, but to get you to learn."* This was a student-directed course in which the students were expected to define the discussion through their questions and requests for more information. The first day of class, the instructor told the students that participation would count for 10% of their grade. He described participation as being composed of being physically present, being willing to ask questions and make comments, and having a good attitude. He further commented that "*a bad attitude will get you a bad grade… a good attitude will get you a good grade*." He defined a bad attitude as not participating, trying to get around doing work, and leaning too much on others. He noted that arguing with the instructor was not indicative of a bad attitude because "*I love it*."

On the first day of class, the instructor handed out a four-page course syllabus which explicitly pointed out that his course objectives were both to introduce the students to solving open-ended problems as well as to address the technical content. The syllabus also explicitly stated that the course would be using a learner-centered pedagogy and included a half-page excerpt from an article describing student-centered instruction with critical passages underlined. He also handed out a three-page description of the final project. All of this textual information was also available online. On the second day of class, Dr. Austin asked the students to "*humor cranky old Dr. Austin"* and use a multi-step methodology that he then began to review. He also posted a pdf of this methodology online. Throughout the course, the instructor continued to vocalize his expectations of the students.

The assignments in the class were composed of concept questions, analysis questions, four project problems, and a final project. The assignments were structured so that the concept questions provided the information necessary to complete the analysis questions which were the basis for the project problems which could then be combined together to create the final project. The concept questions, especially the early ones, required research about the topic. The answers might not be neatly provided by one source. Instead, they might require synthesizing material from multiple sources. This created some reaction from students who wanted to be able to cut and paste their answer neatly from one source. The analysis and concept questions were graded by the teaching assistant and the project problems and final project were graded by the instructor.

The instructor further emphasized his expectations of the students with the first quiz. The two questions on this first quiz were

a) What are the two primary objectives of this course?
b) Why have we adopted a different pedagogical style in this course.

Both of these questions had been addressed on the course syllabus and orally in class. Fortunately the class average was high for this quiz but then the instructor had told me "*I think on this quiz, I'm going to give high marks to everybody…This is the point at which a good attitude, going along with me, is going to get you a good grade, and so I'm not going to ding anybody in particular."*

Findings of Study

I am reporting below some of the preliminary findings of this study. In interpreting the findings, I first compare my results to related previous research. I then look at pivotal assignments and participation, factors I anticipated to be critical prior to the research. Finally I look at the results from the surveys.

Comparison with Prior Research.

One aspect of the student-centered, open-ended classroom is self-directed learning where students take the initiative in deciding what behaviors they need to engage in to learn including defining personal objectives and self-evaluation. The findings of a study of nursing students and faculty in a self-directed learning environment [1] defined five common themes:

1. Defining self-directed learning (SDL)
2. The development of skills in SDL can be a painful process
3. Consistency: Should all students and faculty and courses do it the same way?
4. Confirming: "Am I learning what I need to learn?
5. The need for support and resources to succeed.

Comparing these themes to the results of my study, themes 1, 2, and 5 were very apparent while themes 3 and 4 did not seem to surface. Regarding the first theme, only two of the four students I interviewed had prior experience with self-directed learning. Still many, if not most, of the students in the class appeared to incorporate new terminology such as student-centered and open-ended into their vocabularies during the semester. The concept of the student being responsible for what happens in class, while new and foreign to them at the beginning of the semester, seemed to be accepted as the course progressed. Some students embraced this method, but unfortunately not all. As one student described the course:

> *We're given an open-ended question. 'What can you tell me about it?' Well you can write one line and say 'that's all I know' or you can do a whole bunch of research and not write everything down but give enough of your understanding and then later on if there's any other question you can tell all that you've learned. So, I like what we're doing but it takes a lot of responsibility, but it takes a lot of time to research this material.*

Relative to the second theme, the pain of developing student-directed learning skills was a struggle for some, as expressed through complaints to professor, researcher, and classmates. Many students complained about the workload or that the professor was not doing his job because he was not lecturing. Some students fell behind in their assignment and blamed the professor because he was not strict about deadlines. Students had concerns about how they would be graded, especially for what they considered excessive time spent on the course. The

group work was an especially painful experience for some students. Three of the four students interviewed through the course expressed frustrations with their teammates. These complaints tended to relate to teammates who either didn't do their share of the work or who did everything and prevented others from doing their share of the work.

Theme 5 describes a need for support and resources. Learning to access resources was an important part of the instructor's expectation for this course. Many students spent many hours in the professor's office seeking help with the problems as well as assurance that they were on the right track. The professor made himself very available to the students, telling the class the first day "*If the door is open, come on in."* He also encouraged them to call him at home. Students went to the library, some for the first time in their college career, and also spent time on the Internet researching concept questions. Since there was not a single correct solution, the students were limited in how much they could depend upon their classmates for support although, based upon student comments, there was frequent communication with classmates, especially in the computer lab before class. Students expressed a need for support through feedback from the instructor such as comments on their papers and examples of what a correct assignment that met his expectations would look like. They wanted affirmation that they were correct in what they were doing. One student expressed his desire for feedback from the instructor:

> *I think it would be good to get some sort of feedback saying if our, what we think or saying, is correct and what actually is correct so we can compare and say 'okay, this is what I was thinking and this is what I was supposed to be thinking.'*

While the desire for feedback might could have been interpreted to support outcome four, Am I learning what I need to be learning, I did not make this interpretation. The desire for feedback seemed to be aligned with the desire to meet instructor's expectations in grading.

Pivotal Assignments.

The intent of the series of interviews with the four students was to observe how the students' perceptions of the instructor's expectations of them changed through the semester. The assumption was that pivotal events would occur that affected the students' understanding of what was expected of them by the professor. Three pivotal events related to assignments stood out. The first was Project Problem One, or P1. This was the first assignment graded by the instructor since the TA graded their concept and analysis questions. For this project, students generated some curves through computer modeling. The written assignment for P1 just said to plot certain variables and did not explicitly state to provide comments, however, the professor told them in class that he wanted comments. Still, students handed in graphs without comments. The instructor took off points for a lack of comments. The class average for P1 was 6 out of 10. Prior to P1, students didn't seem to believe that the instructor really wanted what he said he wanted. Instead, many stuck to their old habit from their prior engineering courses – provide the right answer and that's it. But he wanted them to comment about their results and had told them this from the first day of class. One student realized what the instructor expected, or didn't expect, after P1. "*He*

wasn't expecting you to regurgitate. He wanted you to learn. He wanted you to figure things out on your own, have your own insights, to talk about them, not just 'Okay, here's the graph.'" At least one student interviewed thought it was fair for the instructor to expect the students "*to understand that you have to write something down and you have to also show how you got there.*" This same student commented further about how the instructor conveyed his expectations for P1.

> *He gave us insight on what he wanted. At the beginning of class he gave us everything. Everything was online and then he gave us the project so we knew what we had to do… I think he did a pretty fair job on telling us what he wanted from us and when we didn't give it to him he sure let us know that we were wrong, what he wanted and then I think the class responded fairly decently. Like on P1, he gave us that. A bunch of people just turned in graphs like I did and he said 'well that's not what I want.'…*

A second pivotal point was Analysis Problem 8, or A8. For this problem, the students modeled a turbojet engine using the programming tool of their choice. The complexity of the task and the open-endedness seemed to create a new challenge for many students. One student described her experience with A8 shortly before it was turned in:

> *It's really the first time that I've ever failed miserably on something that I've tried so hard on It's been pretty frustrating. I've been up in Dr. Austin's office five times probably since working on this problem and it's not like he's trying to trick us and not give us the right information…he was perfectly forthright with the correct information and we just can't put it together.*

Later she found out that her curves were correct - she was just using a different scale from the one the professor used so her curves looked different. She also "*had one tiny little mistake that all that did was just shift my graph up about ten meters per second so that made it perfect*." But all the time and frustration invested in the problem were not a total waste. "*I sure feel like I know the problem real well. I definitely know what's going on. Not that I learned more, maybe that I'll just remember it better. I learned it obviously because I did it right but I'm sure I'll remember it."*

A third pivotal event was the final project. For many students, this also coincided with completion of Analysis Problem A13 which was essential for Project Problems P3 and P4 which were necessary for the final project. Perhaps due in part to the lack of enforcement on assignment deadlines, many students seemed to be working on all of these at the end of the course, turning them all in on the last day of class. By this time the students were working in groups. For P3, the students compared the performance of the turbojet engine they modeled in A8 and P2 to the turbofan engine they modeled in A13. Obviously any problems with either of these models would create problems with the final project. One group's model was not working for the turbo fan engine. A student on this team wanted to seek external help based upon her understanding of the instructor's expectations:

I don't think it really matters which way we go as long as we have, as far as Dr. Austin is concerned, I think as far as we have tried our best and used all our resources to do our report even if it's not right, I think he'll appreciate the effort. That's what I think. …Because he's always said it's not the final product, it's how you get to it and what you use to get to it. He's always made emphasis that this is the way real life is.

However, her teammates did not agree so they did not pursue outside help.

Participation.

As mentioned, the instructor stressed the importance of participation beginning the first day of class. The format of this class was student-driven using self-directed learning. The students were told that they defined what was covered by the questions they brought with them to class. Some students participated very actively during the class and seemed to have a continuous stream of questions. Others never spoke a word the whole semester. This division between the students who asked questions in class and those who never spoke may well have been indicative of another apparent division – those who *got it* and those who didn't *get it; it* being as much the instructor's expectations of student learning behaviors as the technical content. If students did not engage in the instructor's intended learning behaviors - going to the library, researching on the Internet, asking questions in class, completing their assignments – then they experienced neither the opportunity to learn the technical content nor the problem solving process. Dr. Austin expressed his concerns early in the semester about the students who did not seem to be doing what he expected of them.

If they really are doing their homework and if they will come into the class prepared to ask questions and to understand the discussions that follow from the questions, we're okay, but I don't think that's happening with all of them. Cause you look down at the faces and more than two thirds of them are very bright and alert and the others are sitting there with their eyes half closed or looking the other way .

One student interview participant, who liked the class and did well in it, gave her views on the importance of participation in the course.

There're students that really like the class and students that really don't like the class. …but the students who like the class are going to be the ones that do well. It's not that they like the class because they are doing well but that they like the class so they do well…. every single person I've talked to that doesn't like it hasn't done most of the homework, doesn't ever pay attention so they're not caught up to where the class is so they can't ask any appropriate questions. They don't know what's going on so of course you're not going to like the class. …People that do like it are the type of people that have thrived in the past and enjoy this course because it kind of fits with the way they think. And so they're doing really well. And the people who don't like it would rather do

book problems.

Feedback from the Instructor.

Because there were not answers at the back of the book, students did experience frustration not knowing if they were on the right path or not. Several students commented in interviews about how important examples of what the instructor wanted were in helping them to understand his expectations. Since the assignments built upon each other, students expressed a desire to have their earlier assignments returned along with the instructor feedback so that they could make corrections in their later assignments. For instance, students cited using the feedback from P1 to make changes in how they did P2. Unfortunately, the instructor is not known for his promptness in returning graded assignments so timely and direct feedback about their projects was sparse. However, one way the instructor provided feedback to the students about what he expected from the assignments was by posting his solutions online as well as reviewing them in class. One of the students commented on how seeing the instructor's solution of P1 affected him.

> *I didn't understand at the time but when he gave back his P1, gave back our P1, I got to comparing what we did and he did, definitely saw the difference so that really helped out on what was expected …I think some people, they turned in a pretty good portion of P1 but they still got a bad grade because it wasn't exactly what he wanted. But I compared with the people who sat around me, saw what they had, saw their grade and it's like 'okay, well that's what he wanted. Now I understand.'.*

Still, feedback in the form of grades was a factor in the course. Sadly but not surprisingly, the students' concerns about meeting the instructor's expectations of them did not seem to be driven so much by a desire to experience the learning opportunities that might result from these behaviors but more by a concern over the grade they would receive from the course. One student actually liked not really knowing where she stood in the class due to lack of feedback. Since she didn't know her grades, she could assume she was doing well and stay motivated.

The students expressed concerns about how the instructor could grade them fairly, especially regarding their effort. One particular concern seemed to be that students would receive good grades based upon the efforts of their teammates with students citing examples from previous sections where this occurred. The instructor did have the students complete individual evaluation forms for themselves and their teammates in an effort to fairly grade effort. One student, in discussing or perhaps justifying how some students, including his team, omitted parts of the final project commented, "*he can't fail the whole class.*"

Surveys.

As mentioned, three surveys were given during the course. The first was a screening survey to gather student characteristics and attitudes mainly related to project-centered courses. The second and third surveys asked for student definitions in response to the open-ended request: "Please

write your understanding of what your professor expects/expected from you for this project." From the student responses to this request, I created thirteen descriptive categories as defined below:

1. Make engineering decisions
2. Design/analyze engine
3. Effort and initiative put forth
4. (Displaying) Skill, understanding and knowledge gains
5. Not about right answer
6. Solving (open-ended) problems
7. Importance of process
8. Real world applications
9. Seek and use external resources
10. Work with others
11. Increase understanding of Thermal – Fluids
12. Make connections
13. Dazed and confused

I then counted the number of "hits" for each category on the student responses for the mid- and end-of-semester surveys. Since 35 students took the mid-semester survey and only 31 took the end-semester survey, I reduced the data to percentages of respondents. The results are presented in Table 1 below.

Category	Mid-semester (% of respondents)	End-semester (% of respondents)	End-semester – Mid-semester (% of respondents)
1. Make engineering decisions	46	29	(-17)
2. Design/analyze engine	60	26	(-34)
3. Effort and initiative	20	29	9
4. Skill, understanding and knowledge gains	6	45	39
5. Not about right answer	14	32	18
6. Solving (open-ended) problems	40	45	5
7. Importance of process	14	26	12
8. Real world applications	29	32	3
9. Seek and use external resources	26	29	3
10. Work with others	20	23	3

11. Increase understanding of Thermal – Fluids	63	29	(-34)
12. Make connections	29	19	(-10)
13. Dazed and confused	34	13	(-21)

Table 1. Categorical results from surveys two and three

This data appears to indicate some changes in how students view the instructor expectations. Looking at the last category, the percentage of students who did not know what was expected of them fortunately went down from mid-semester. Looking at categories 2 and 11, students at the end of the semester seemed to give less focus to learning the science and more to focusing on improving their skills and recognizing that the course was not about the right answer but about the process, a message the instructor continually stressed to them. Category 4 included references to reports and demonstrating or communicating their understanding of the material. Since their final project was due the day after they completed this survey, they were probably very attuned to those expectations.

Conclusions

This was an exploratory study of a relatively unexplored topic that I believe is essential for successful implementation of projects into the undergraduate engineering classroom. If students don't correctly understand what they instructor expects them to do then they're not going to engage in those learning opportunities, especially if they are used to learning in a different environment with different expectations.

In the story *Who Moved My Cheese*[2], Sniff and Scurry are two little mice and Hem and Haw are littlepeople who went to Cheese Station C everyday to get their cheese. One day there was no cheese. The little mice promptly moved on to find new cheese but Hem and Haw stayed on, waiting the old cheese to appear. Haw eventually gives up on the old cheese and ventures out in quest of new cheese while Hem stayed on waiting for the old cheese to appear. Even after Haw brought him some new cheese he had found, Hem continued waiting for his old cheese. This story is a fitting analogy for what I saw with the students. Some seemed to immediately embrace the change of expectations of them in the student-centered classroom, like the little mice Sniff and Scurry. Others, like Haw, eventually realized their world had changed and they would have to change with it. Others, like Hem, waited on their old cheese to return - the lecture - and blamed the professor for their lack of success in the course. Project-centered courses can be a memorable experience for those students who *get it* and accept their new role in a student-centered learning environment and a semester of misery for those who don't *get it*. One student reflected upon how he benefited from the class.

> *This class has really opened my eyes. ... how to know what to expect from other people and where to go to find the answer that you need to finish it out. It may not be the complete answer but you can use some sort of reasoning to come up with some sort of educated guess. ...I learned a lot about where to go to find resources for other projects.*

I don't know if that was Dr Austin's whole outlook. I don't think he wanted us to stay focused on just this class. I think he wanted to open it up to where it's more general, to know where to go for a whole bunch of variety of different concepts. … I feel that I learned at least where to start and who to ask to at least suggest a starting point…. Now, at least I can say I've had one project, I'll at least put my foot in and say I'm ready to take it on. I can at least give it my best shot now.

But then, like the old saying 'you can lead a horse to water but you can't make him drink,' students may understand what is expected of them but that doesn't mean they are going to engage in those behaviors. On the end-of-semester surveys, one of the responses I considered exceptional in describing the instructor's expectations was written by a student who earned a "C" in the course. This student seldom participated in class, sometimes slept in class. But he understood what was expected of him. Did he just choose not to do engage in the expected behaviors? If so, why not? Other students expressed remorse on their end-of-semester survey that they did not engage in the expected behaviors.

Suggestions for Faculty.

The challenge for faculty is to ensure all students *get it,* that all students understand what is expected of them. Based upon this study, I have the following suggestions for instructors seeking to create an open-ended, student-centered learning environment where students *get it* when addressing complex problems. First and foremost, explicitly define your expectations in writing, especially if you have reason to believe these expectations are unique, and re-emphasize them orally. Observing students in the classroom, they seem to write down in their notes what the professor writes on the board but not so much what he says in class. Maybe they believe if it wasn't important enough for you to write down then it must not be that important.

Provide prompt feedback. Your feedback may be more critical in a student-centered course with complex problems than in a traditional course with simple problems from the book. While there may not be one right answer, there are still wrong answers and misconceptions. Students seem to want reassurance that they have not gone astray. Provide completed examples of how you expect the assignment to be performed. For instance, in the course of this study, the instructor posted his solutions to some assignments online. Student used this as both a reference to see where they may have gone astray and as an example of what he expected. You could also use outstanding examples handed-in by students, posted or worked out in class. Provide further feedback through timely return of assignments with meaningful comments. Several of the students interviewed brought up the need for comments on their papers. Remember that feedback can be two-way as well. Establish an open communication with your students and request their feedback about what they believe you expect from them.

Remember that you are more likely to get what you want if you ask for it.

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