

**AC 2009-1394: TEACHING THE MILLENNIAL STUDENT, ADAPTING THE
LEARNING FRAMEWORK FOR MATERIAL SCIENCE**

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Abstract

Faculty are responsible for teaching courses that are current and use pedagogy up to date with the students of today. The current generation of university students consisting of those born after 1980 and graduating high school following the year 2000 are pegged the Millennials¹. This generation, has demonstrated many unique characteristics that can make them successful in the academic and economic world of the future. For the Millennials cell phones, text messages and instant messages are their chosen communication methods. For these student to walk into a classroom and be “lectured at” for an hour is near death. As the students change the pedagogy must also change. Taking concepts from Educational Psychology the cognitive learning framework will be used to construct the study. Introduction to Materials Science, MEEN 360 is redesigned using this learning framework. Some believe that there are two ways that teachers can add significance to teaching and learning. One is by helping students learn about additional things, e.g., about themselves, about others, about learning. A second way is by helping students change in different ways, e.g., by attempting to change their ability to think about the subject, their ability to "do" something, their ability to connect different kinds of knowing, or the degree to which they "care" about something². Thought was put into creating an instructional strategy not just changing a few teaching techniques. The approach involved creating a “Castle Top” diagram for the course which will is explained as a diagram looking like the turrets on a castle containing in class and out of class activities². Is this extra work on the part of the faculty necessary or does the improved pedagogy also serve to increase the millennial student’s self efficacy and confidence. Formative and summative student assessments will be discussed in the paper. Assessment tools included a pre and post concept inventory of learned materials and longitudinal studies throughout the course of student confidence and attitudes. The student’s feedback demonstrated that not only did the students express satisfaction with the style of the course but the data showed that their confidence improved and the summative data has served as a source of faculty discussion.

Introduction

Our students today come primarily from the millennial generation³. Professors should try to understand that Millennials consume and gain knowledge from a wide range of media, often simultaneously. These students are characterized by the following unique characteristics taken from Jeanna Mastrodicasa in her article on the Millennial Generation³.

- This generation was wanted and they feel individually and collectively special as a result. They feel connected to their parents. They are optimistic and engaged.
- This generation was highly protected and sheltered by parents and authority figures. Many had overindulgent parents. They were rarely left unsupervised. They are comfortable with significant parental involvement, and they expect parents and college

employees to resolve their conflicts and to protect and nurture them. They trust institutions, but are skeptical of authority figures.

- This generation is motivated, goal-oriented, assertive and confident. They want to make a difference. They are civic-minded and value service learning and volunteerism. They believe college will help them get a great start in life. They expect to advance rapidly in the workplace.
- This generation is team-oriented. They want to be part of the group, like to congregate and fear being seen as non-conformist. They are in constant contact with peers via cell phones, text messaging and social networking websites. They prefer egalitarian leadership over hierarchies.
- This generation is high achieving. Even in elementary school, they were expected to earn good grades, work hard and pursue extracurricular activities. They are the smartest generation ever, as evidenced by rising proficiency in standardized tests. They are focused on achievement rather than personal development. They may not value the benefit of lifelong learning.
- This generation is focused on achievement and they feel pressured to succeed. They are used to filling every hour of the day with scheduled activities. They've been pushed to succeed and feel pressured. They had more homework than previous generations. While they are efficient at multi-tasking and believe it is a smart thing to do, they have challenges with time management and have zero tolerance for delays or idle time.
- This generation is accepting of lifestyle, racial and ethnic differences.

As the students change the classroom pedagogy must also change striving for a more involved class and therefore greater understanding and learning by their students. When one looks at all of the common traits listed above it is difficult to the most effective method to teach them but that is really the point many methods are needed. The psychologist Vygotsky is credited with developing the concept of Social Cognition and a major part of the millennial student characteristics is that they are social creatures to a fault. The theory of social cognition states that "social interaction and culture has a dramatic impact on cognitive development and that cognitive processes (language, thought, reasoning) develop through social interaction. Learning is largely mediated by social interaction of students and "More Knowledgeable Others" (e.g. teachers, parents, coaches, peers, experts, etc.)⁴. The classroom must become more active and engaging. When the students in the course becomes more involved and the professor puts more thought into the course the desired outcome is quite likely. Dee Fink in his workshops across the country states that there are two methods engaged teachers can utilize to add meaning to the experience. "One is by helping students learn about additional things, e.g., about themselves, about others, about learning."² Students survey responses reflect that they prefer to see online course-management systems, like WebCT and Blackboard, operate faster and be more interactive, presenting things in video or audio formats. The course outline and the results from the summative and formative assessment will follow.

Course Design and Assessment

This is an introductory material science course which requires some "lower level" learning, i.e., remembering basic information and concepts. Expanded outcomes also help impart confidence and some higher level learning including problem solving, critical thinking, and creative thinking. The Castle Top course design created by Dee Fink was utilized to plan the course. The university is a Blackboard campus so the tools from that website are used in the plan. These include online quizzes before class and a large library of external links that are used for resources. A sample of the first two weeks are displayed in Figure 1. Notice that the plan is divided into inside and outside class activities, all of which are thoughtfully designed to add meaning and content to the course. These activities (a) get students ready or prepared for class, (b) give them opportunities to practice—with prompt feedback via the Wileyplus platform—doing whatever it is you want them to learn to do, and (c) allow them to reflect on their learning. The objective is to produce a sequence of activities that build on each other. One particular activity was the construction of a poster and presentation of a real life failure event, sample of which are shown in Figure 2. Another activity was for a pair of students to create a class lecture on several sections of a chapter and then to present to the entire class while being critiqued by their peers. Multiple groups covered the same sections and the student engagement was high as were the learning results as different group styles were offered.

Inside Class		*Hello * Group activity		*Lecture, *Chemistry review game	
Outside Class	Bookstore, get notebook, Check Blackboard		*Get to know Wileyplus HW		*HW *Sports Material Activity

Week 1 Castle Plan

Inside Class		*Lecture *Group problem		*Team quiz *Lecture	
Outside Class	*Pre-lecture reading *Blackboard quiz		*HW		*HW *Presentation preparation

Week 2 Castle Plan

Figure 1. Notice that the plan is divided into inside and outside class activities, all of which are thoughtfully designed to add meaning and content to the course.

Formative Assessment was administered via the Blackboard platform. These surveys asked both reflective essay questions and likert type questions which intend to facilitate student efficacy reflection. These were delivered anonymously with n=35. This information was compiled some of which is displayed in Figure 1. The results were shared with the students and provided information to adjust teaching and learning while they were happening. In this sense, formative assessment informs both teachers and students about student understanding at a point when timely adjustments can be made. There was also included in the assessment plan formative peer-assessment of the previously mentioned student presentations.

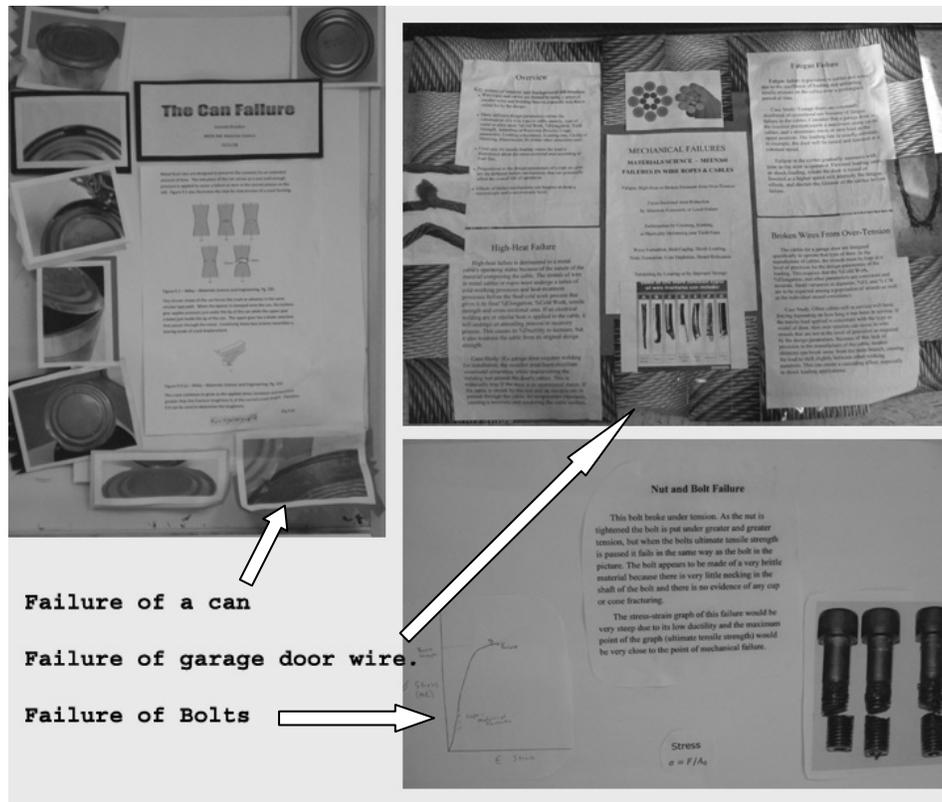


Figure 2. Out of class activity on real-life failure which as then presented to the entire class.

The qualitative formative questions that were administered late in the semester with some sample answers are as follows:

1. Discuss what can you do to improve the class learning environment?

I think that the student is responsible for his or her own learning, as much as the instructor is responsible for adequately providing and meeting course objectives. My input into the classroom would be making myself better available for extra-curricular study sessions in order to supplement instruction from the teacher in a better or more

organized fashion, especially when it comes to understanding how to successfully negotiate homework problems from WileyPlus.com.

I can improve the learning environment by staying on top of reading assignments before class lectures and contributing positive responses to questions asked during class.

To improve my class learning environment I can come to class prepared and ready to learn. Participate in class discussions as well as take detailed notes. Make sure that all outside distractions such as phones, games and any other items are put away and out of sight.

The answers to question one demonstrate a reflective quality to the student responses and confirm that the classroom plan is having the desired effect. Students are more aware of their personal responsibility for their education. Many universities have been slow to create environments in which the students participate actively in their own education. As Vygotsky recognized in his Social Development Theory the teacher should not just be dictating meaning to students for potential recitation, the social development theory has the teacher working in partnership with her students in order for students to create their own meaning⁴. The answers to question two confirm that the Millennial student appreciate the positive energy and engagement of this classroom plan. These confirm again the premise from social development theory.

2. What do you like about the class, give examples

I like that it explains slightly more in depth of how materials act other than saying material has X properties because it just does. I how my other classes are relevant to this class (chemistry/cal I/learning to curve fit).

Students have the opportunity to interact with each other for assignments and study groups. The professor makes an effort to present creative teaching methods so that students will understand and retain the discussed information. The professor is also open to suggestions unlike so many other faculty members in the College of Engineering!

I like all of the interactive sites that we are provided with as well as the tone of the class discussions. I love that the lectures are up beat which makes it easier to pay attention especially when the class starts at noon which is when I start to run out of energy. I also like that we are encouraged to participate in the discussions, everyday we are asked what we learned from the previous class

The quantitative formative questions were asked in likert form and were interspersed in a longer survey. They were chosen from the NSF sponsored website titled, Online Evaluation Resource Library (OERL)⁵ They are listed below and the questions were asked both at the start of the course for a baseline and again late in the course. Comparison of the sets of data are displayed in Table 1 and Figure 3.

A. I prefer course material that is new and challenging to material I have previously studied.	B. The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.	C. I expect to do well in this class.	D. I'm confident I can learn the basic concepts taught in this course.	E. Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	F. I'm confident I can understand the most complex material presented by the instructor in this class
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Table 1. Formative questions asked to reveal student confidence and self efficacy.

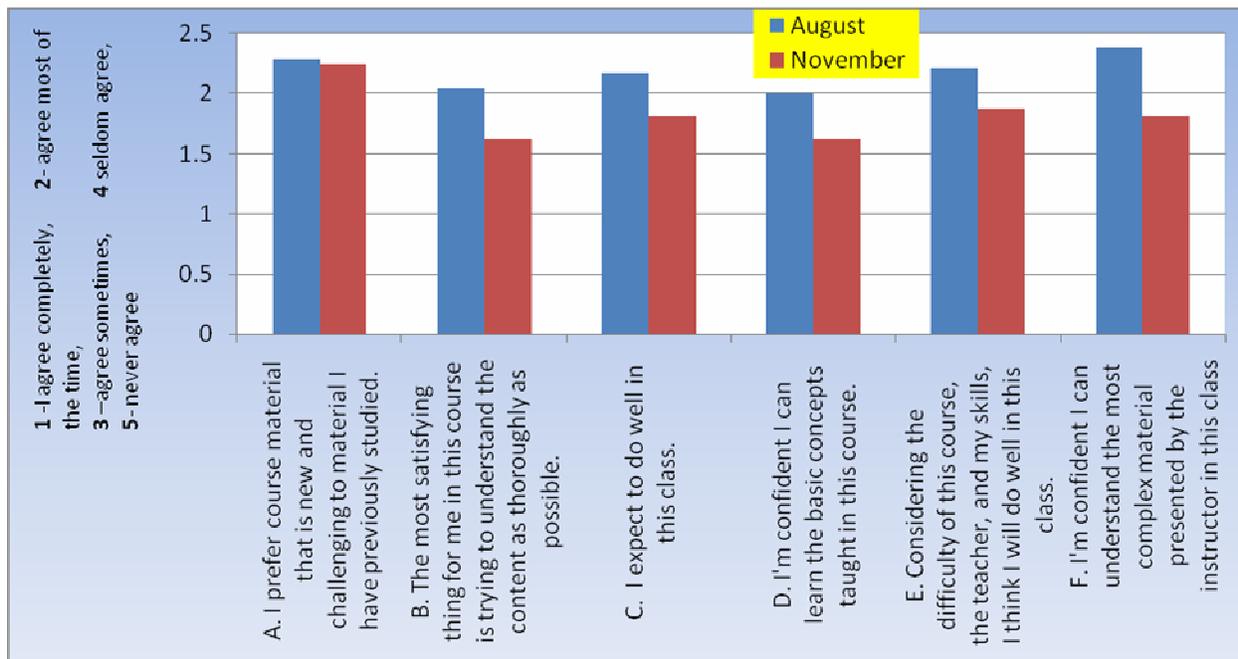


Figure 3. Student likert scale opinion survey. Start of the semester, August and late in the semester, November, notice changes in the confidence in their learning.

The results in Figure 3 show that each area of assessment improved in that the values decreased later in the semester which mean they are approaching 1 which equates to “I agree completely”. Their confidence in question “F” displayed the greatest improvement.

Summative Assessments are given periodically to determine at a particular point in time what students know and do not know, for this course these included the Materials Concept Inventory (MCI) pre and post course, 3 tests, 8 Blackboard online quizzes, in class group quizzes and the final exam. The Blackboard quizzes were implemented to promote pre-class preparation and not to assess great knowledge. Questions were kept simple but varied from short answer, and essay to multiple choice.

The MCI demonstrated many student misconceptions in the class. This instrument was created by Dr. Richard Griffin and Dr. Steve Krause⁶. This instrument tests for the level of conceptual

knowledge of the subject matter before and after the course. The misconceptions have been utilized as question responses, or “distracters”, in the multiple-choice MCI test. They have been generated from a literature survey of assessment research in science and engineering in conjunction with extensive student interactions. The test was administered the 1st day of class and then again the last day of class. Improvement varied but overall displayed a 12.5% improvement. The results were lower than hoped but gives opportunities for improvement in the future and also can be the result of the fact that some topical areas may receive emphasis in the introductory materials course at different schools depending on the needs of their students.

Conclusion

The rationale behind our teaching is the promotion of student learning. All decisions relating to a given course from the selection of textbook and online resources to the assessment process should be critiqued by their role in this process. The quality of these decisions is a function of how well the course is designed and how well the design components are incorporated. Because few college professors understand the concept of an integrated course design, and even fewer have the skill required to create one, this paper is offered as a way to improve this vital process. The student’s feedback demonstrated that not only did the students express satisfaction with the style of the course but the data showed that their confidence improved and the summative data has served as a source of faculty discussion.

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