AC 2009-460: INTEGRATING STUDENT EXPERIENCE INTO THE CLASSROOM

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Integrating Student Experience into the Classroom

Abstract

Engineering educators seek to inspire their students to integrate classroom theories with their own experience. This paper describes the development of an activity integrating co-op experiences and/or research interests with classroom learning. The resulting instrument, CITIES – Beyond the Classroom, will be useful for STEM educators to create a participative classroom environment. The instrument may be adapted for facilitation in diverse classes. An overview of the CITIES instrument and preparatory materials as well as preliminary assessment of the instrument will be presented.

The purpose of this instrument is to develop a student activity that connects classroom work with contemporary issues and real-world applications. Using a methodology based on expert performance, students will analyze class concepts through the exposure and acquisition of new information from a variety of resources. They will describe to others what they have learned, and assess their own communication skills through a quiz that they develop themselves. The principle student activity is an oral presentation communicating information, applications and citations, but the real value in the methodology is that it jump-starts the novice toward the approach experts would use in preparing a presentation.

CITIES is an acronym that describes the intent of the exercise: Contemporary Issues That Impact Engineering Solutions. It may be modified for use in classes outside of engineering with a slight modification to Contemporary Issues That Inspire Extraordinary Solutions. Regardless of the context in which it is used, the CITIES instrument provides a step-by-step method to take classroom concepts and apply them to real-world applications. The focus of this instrument is to guide both the instructor and the students in a more structured environment than simply assigning presentations on topics with applications. To support the meta-level process, the instrument contains preparatory information for the instructor and the student handout. The CITIES methodology was created as part of a Pacific Crest Teaching Institute.

Purpose

The purpose of this paper is to introduce a tool that can be used in many courses to draw upon experiences beyond the classroom, and bring outside interests into the discussion of course topics.

In the contemporary education environment, there is a need to incorporate more activities that emphasize relevance and professional practice in the STEM classroom.[4] This tool provides an activity that engages students in the preparation of a professional presentation, and inspires them to think more broadly about a classroom topic by exploring applications connected to their interests and/or experience.

Background

The question often put to instructors by their students, "Why do I need to know this?" is especially popular in engineering, science and other technical courses. This paper describes an activity that addresses this situation by guiding the student in exploring possible answers. Contemporary Issues That Impact Engineering Solutions, or, for classes outside of engineering, Contemporary Issues That Inspire Extraordinary Solutions (CITIES) brings together several objectives common to classes in a variety of disciplines.

Relevance is intentionally emphasized in undergraduate engineering and other technical programs. Intern, co-op and capstone experiences and preparation for professional certification are popular benchmarks for relevance in these programs.[2, 3] At Kettering University, all students participate in a mandatory co-op program from their first year, alternating every quarter between academic terms and co-op work at an industrial or research-oriented sponsor. These culminate in a sponsor-driven thesis project, required for graduation.

This fully co-operative model of education demands connection to practical applications in academic courses. Students expect course topics explicitly tied to industrial needs or professional skills. Additionally, students bring a rich variety of experiences from their work terms, and will readily share what they've learned if given a framework.

CITIES provides this framework in an active learning context. At face value, students prepare and deliver a presentation that adds value to the class by describing applications of course topics. At the meta-level, the structure of this framework intentionally develops an expert approach to gathering information and professional presentation.

The student has the burden to create an effective, engaging, and meaningful presentation, but is given the tools and process knowledge for the task. The critical components of this instrument are: (1) ownership of the process by the student, with the instructor available for guidance; (2) a methodology for the student to follow, modeled after expert or best practices; (3) a set of graduated "Critical Thinking Questions" that lead the student to deeper understanding of the methodology, and (4) strong assessment from the student and peers, coupled with fair evaluation from the instructor.

The initial CITIES format was developed by one of the authors and used in an early form for student presentations. Development of the CITIES activity was accelerated during a Pacific Crest[1] event, the Activity Design Institute, at Kettering University. Support from the university Center for Excellence in Teaching and Learning (CETL) for events such as these encourages cross-discipline interaction and collaboration with faculty from different departments, and is gratefully acknowledged.

Hypothesis

The central hypothesis for using the CITIES format is that by allowing students to actively contribute to the classroom through a focused presentation, further depth of understanding will be achieved both for the presenting student and the class. In addition, a breadth of topics not considered in the initial syllabus will be naturally integrated into the class.

The learning objectives of CITIES contain five key components. They are intended to allow students to (1) connect, (2) demonstrate, (3) seek, (4) describe, and (5) communicate their ideas by following the CITIES process. Specifically, co-op work experiences and student-led research are used to bring real-world applications to theoretical course topics. The CITIES format will aid students by modeling the methodology used by experts to research, prepare and present ideas with the goal of life-long-learning and expanded interest in related subjects. This methodology is described to students in eleven steps, given in Table 1.

Table 1. CITIES Methodology

CITIES* Beyond the Classroom – *Integrating and Communicating Knowledge*	
Gathering and Assembling Knowledge	
1. Summarize the topic.	Review the topic from classroom materials, and bring out the key ideas and elements in a concept map, outline, or other appropriate summary.
2. Brainstorm applications.	Consider applications where these key elements might impact industry. This will help you search in the next step.
3. Research applications.	Use resources to explore applications, and find out how the topic is applied in practical ways. Keep track of your findings with good notes and a growing bibliography.
4. Assemble research notes.	Bring together your research notes, and make sure they are organized for later review. Highlight, categorize, or create a table of contents as appropriate.
Integrating Knowledge	
5. Identify connections.	Review your research notes to list or highlight connections between classroom topics and application.
6. Identify divergence.	Review your research notes and find any areas where practice and theory diverge.
7. Create an outline.	Create a logical flow to structure the presentation, including a brief overview of the topic (Step 1), a description of the application you're focusing on (Step 3), and your analysis of these (Steps 5 and 6).
Communicating Knowledge	
8. Create slides and notes.	Flesh out the structure of the outline with information from your research notes. Be sure to cite sources, and add notes to each slide to guide the speaker.
9. Practice delivery.	Use the slides and notes to deliver the presentation to a test audience, just as if you were in class. Keep track of the time, and ask for constructive feedback from the listeners.
10. Assess presentation.	Find the strengths and areas for improvement, then refine the presentation.
11. Create quiz	Highlight the main points of the presentation in the quiz.

Experiment

There have been several attempts at using various forms of CITIES in the classroom, however, it was formally assessed in the Fall 2008. The formal methodology was used in a Junior/Senior level core Industrial Engineering Class titled IME453 Systems Analysis III: Scheduling. One of the co-authors was the facilitator. The full instrument contains notes for facilitation.

The ABET syllabus for IME453 contains three course learning objectives that are mapped to six specific course topics. Thus, topics for the CITIES presentation were chosen from the course topics: (1) Principles of lean manufacturing (2) CPM/PERT analysis and justification (3) Inventory techniques, EOQ (4) Forecasting techniques (5) Scheduling techniques and (6) Operation, product, project, and system analysis techniques.

The final matrix of students assigned to topics is shown in Table 2. Note that this was an eleven week course with lectures on Monday (M) and Thursday (R) and that CITIES presentations were completed by the seventh week of the term. The instructor chose to have individual CITIES presentations for this experiment.

Twenty students were enrolled in the Fall IME453 class and asked to rank their top three choices from the list of six topics to research further using the CITIES format. The instructor assigned topics to each student giving preference to the top ranked choices. Approximate dates were assigned for each topic and actual dates were assigned as the term progressed and each topic was covered in class. The column labeled "initial approval" required that students sign their initials to show approval of the assigned topic and tentative time frame at the beginning of the term. Approximately three iterations were required in order to satisfy all students with a topic of their choice and a good time in the term.

A review of Table 2 shows that 15 of the 20 students were assigned their first choice of topics. Three students were assigned their second choice and only two were assigned their third choice. All students initialed the form at the beginning of the term so that they would be able to prepare for their assigned topic. Another important item to note from Table 2 is that although students were assigned individually to topics, the topics were clustered together for a common topic to be discussed. In addition, in most cases the student chose a specific title corresponding to their broad course topic.

An assessment was taken in the form of a student survey after all 20 students delivered their individual presentations. The survey was given online via Blackboard, anonymity was assured, and class time was devoted to the survey completion. Thus, 100% of the students in the class responded to the survey. The results of the assessment are given in Table 3 with some preliminary analysis and interpretation.

Table 2. Student Assignments to Course Topics

	Week	Day	Forecasting	Lean	Inventory	Analysis	CPM	Scheduling	Initial approval	Commit to a Specific Title
1	2	R	1							Judgemental forecasting
2	3	M	2	3		1				Lab planning based on forecasted trends
3	3	R	3	2	1					Inventory - tool crib implementation
4	4	M		1						5S principles
5	4	M		1	2			3		Lean Design
6	4	R		1	2			3		BPS leanmfg principles/Pull system
7	4	R		1	3	2				Flow - one piece flow
8	4	R	2	1				3		-
9	5	M		1	3			2		Line Layoutminimizing space, time, & workers
10	5	M			1					Different Inventory Methods within General Motors
11	5	M	3	2	1					Prototype Inventory
12	5	M			1			2		Inventory control using JDE software
13	5	M		3	1	2				Inventory control methods
14	6	M				1				Project analysis using A3 Reports (visual charts)
15	6	M				1				System operation analysis in health care
16	6	M		3		1		2		System analysis tech
17	7	M	2			3	1			-
18	7	M	2				3	1		-
19	7	M		2				1		Job Shop Scheduling
20	7	M			1	3		2		Inventory control on tooling and raw material

Table 3. Student Survey Data

n = 20 (out of 20 students enrolled in Fall 2008) All values are percentages (%) of the 20 students.	Strongly Agree	Agree	Neither agree nor disagree	Dis-agree	Strongly Disagree
Learning Objectives stated in the student handout:					
The CITIES project allowed me to *connect* classroom work with contemporary issues and real-world applications.	45	50	0	5	0
The CITIES project allowed me to *demonstrate* my ability to analyze class concepts through the exposure and acquisition of new information.	25	55	10	10	0
The CITIES project allowed me to *seek* out a variety of resources to find information.	10	50	25	15	0
The CITIES project allowed me to *describe* to others what I have learned.	40	50	5	5	0
The CITIES project allowed me to assess my *communication* skills through a quiz.	20	50	20	10	0
The performance criteria were fair and appropriate.	45	55	0	0	0
I followed the CITIES process exactly as written.	10	45	10	35	0

Analysis of the student survey data suggests that there were positive and negative aspects of the CITIES project. On the positive side, a majority of the students agree or strongly agree that all of the learning objectives were met. Second, 100% of the students agreed or strongly agreed that the performance criteria were fair and appropriate. On the negative side, 15% of the students did not agree that the CITIES presentation allowed them to seek out a variety of resources to find information. Internet sites, class notes and personal interviews seemed to be the primary resources that students cited as observed by the professor. Also, 35% of the students did not agree that they followed the CITIES process exactly as written. These findings suggest that some modifications may improve the CITIES process.

In addition to the formal survey with quantitative values, anecdotal information was solicited through three essay responses related to the strengths, areas for improvement and insights (SII) of CITIES. Selected responses were categorized, prioritized and summarized.

Strengths

In response to the question "Please list strengths of the CITIES project" students were enthusiastic to provide feedback.

More than half of the essay responses (12/20) related to the connection between the workplace and the classroom as a primary strength of CITIES. They commented that students were better able to understand the material by demonstrating how the material is applied and useful in their own workplace and the workplace of their peers. Further, CITIES allowed students to see what others do in their jobs and apply these topics to classroom learning.

Approximately a quarter of the class (6/20) discussed the necessity of presentation skills as one of the strengths of CITIES. They appreciated gaining experience in presenting information and also felt that the CITIES presentations kept the class interesting. They also felt that the CITIES process enabled the class to include new and deeper topics than what was currently taught in the class. Students enjoyed the interaction while learning and found that this was a good way to get everyone interested in the topic by presenting to their peers. Students commented that the activity portion of the CITIES presentation required interaction with all students and brought everyone into the topics.

Several students (4/12) felt that CITIES forced students to go in depth on a specific topic and showed evidence of the students interpretation of the material covered. They felt that it allowed students to go farther in depth than the simple examples in class and didn't mind the extra work outside of class. Individual single comments related to the strengths of CITIES included "I thought the convergence/divergence part of the CITIES presentation was important" and "It uses a different, contemporary approach to teaching material."

Improvements

In response to the question "Please list areas for improvement for the CITIES project" students were not shy about what specific areas should be improved in the CITIES process.

A majority of the students (7/20) mentioned the need to be more specific about the topics for presentation and avoid repetition. Some suggested that students work in groups to avoid repetition and use less class time. They went on to explain that each person would have the help of classmates to research their topics and the class would be able to take away more information and experiences from each presentation. Another area of improvement for a majority of students (7/20) was that some students did not take the assignment seriously if students regurgitated class information and applied nothing to real life. They complained that some quizzes were too easy and pointless. They mentioned that some presenters used the presentation to waste time and ask dumb quiz questions to boost grades.

Many students (5/20) felt that CITIES could be improved with more description of the process itself. They wanted more explanation in class as to the goals and expectations. They felt that following the CITIES format was a bit confusing. Some students (4/20) felt that presentation time should be limited stating "…while the CITIES presentations were very informative, lecture time was sacrificed" and that the instructor should be more diligent in enforcing the time policy. Some students (3/20) felt that there was no improvement needed stating "Perfect!" while one student stated that they would not like to do the CITIES project again. There were some student comments (2/20) stating that material should be covered in class prior to any student presentations and that there should be more direct correlation between course material and the presentations.

Insights

In response to the question "Please list insights or comments related to the CITIES project" students had the opportunity to offer comments not included in the strengths and improvements section. Many comments were repeated from the previous sections but additional insights were also gained. Students enjoyed the interaction and appreciated the connection between classroom concepts and their workplace. They would like the topics to be more focused and the format refined for better understanding and more in-depth presentations. Some actual selected comments include "I think it's a very strong activity that provides a good amount of instructional and interactive value. It makes the class new and interesting and helps the class to avoid monotony." One other insightful comment: "Please keep up the good work. I came to this school to fuel my passion for making workplaces a better place and your teaching style embraces this. I have too many classes that fuel my hatred for the acceptance of adequacy and complacency…"

Conclusions and Future Directions

The CITIES format will be used a variety of classes with assessment data gathered to see if it is appropriate to all types of courses from multiple disciplines. It will be interesting to note if the process lends itself better to core courses or elective courses. Further data is required to see if the CITIES process can be applied equally well to first year students as well as graduating seniors. Student feedback will continue to influence the CITIES format as it is used in subsequent classes. In future offerings, a more thorough review of the CITIES process by the instructor will improve its usefulness as mentioned in the student survey. Further, the instructor should encourage additional resources to show convergence and divergence of the chosen topics.

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