Integration of Desired Learning Outcomes in a First Year Design Course

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Abstract – Our first year design and communication course is an interdisciplinary course involving the application of engineering principles, design, communications, leadership and project management concepts through a sequence of team-based design projects. Integrating and translating these components from lectures to labs and vice versa is a challenge. During the upcoming Fall semester a paper project will be introduced that combines all communications deliverables into a submission for a student design challenge. The instructors expect a greater appreciation for the communications components as a part of the design course.

Keywords: Engineering design, communication, integration, paper project, student design challenge.

1. INTRODUCTION

The paper addresses the critical need to fully integrate most, if not all, learning outcomes in a first year design course. As background, in fall 2009 the Schulich School of Engineering adopted a first year design course based on a theoretical introduction to design and communications in a lecture environment, followed by hands on experiences in a workshop/design project environment. While the course was deemed largely successful, it was felt there was a partial disconnect between the material given in the lectures and the skills and knowledge required for the communications workshops and projects.

2. PAST EXPERIENCE

2.1. Lecture component modifications

For the fall 2011 offering of the course, the lecture component of the course was revised to increase the linkages between the lectures and the projects. This was partly done by replacing more theoretical project

management material with more practical hands on techniques that can be applied to student's projects (Fig. 1). Without being able to reference quantitative studies, the teaching team also found that lectures that focused on presenting foundational material were not very effective compared to lectures that integrated case studies or discussions of projects the students were completing (Fig. 2).

Fig. 1. Work breakdown structure as taught in lecture and applied in lab.

Fig. 2. Morphological chart and selection matrix as taught in lecture and applied in lab.

2.2. Integration using a paper project

With respect to integration and impact of the communications component of the course, a revamping of the communications content is proposed for the fall of 2012. Students were taught communications components in the past, but often these were seen as ‘make work’ assignments. The instructors did see many positive outcomes: an increase in sketching in the logbooks (Fig. 5) and the use of concept sketches during meetings (Figs. 3 and 4)

Fig. 3. Sketching practice.

Fig. 4. Concept sketches.

Fig. 5. Concept sketches and development.

A paper project based on a broad real world student design challenge will take the place of separate communications portfolio components. The project will follow the design process ‘via’ communications deliverables, in our case: concept sketches, technical writing components (from grammar practice to various stages of report writing), CAD modeling, oral presentations, a final report and a slide presentation (Fig. 6). These components are also required for the competition. By modeling an entire design communication process, we expect the communications components will be seen as integral to engineering design.

3. CONCLUSION

Communications is vital to any engineering design process. Students in the fall of 2012 will work towards a student design challenge as they fulfill their communications requirements in our course. We expect that participation in this real world challenge will encourage and excite the students while completing this integral part of the course.

Acknowledgements

We would like to acknowledge the students who allowed us to show their logbook pages.

Engg 200 Fall 2012: Paper project plan

Week	Comms Lecture	Workshop/Lab	Due	Learning Outcomes
4 -- Oct. 1	Communications #2 • Sketching practice • Writing in Engineering • In-class writing exercise • Sust. workshop • [LP #2]			<ul style="list-style-type: none"> • Produce introductory engineering drawings and sketches • Produce introductory technical reports • Interpret ethical, social and environmental influences • Impact of engineering on society • Practice writing with correct spelling, punctuation and grammar • Practice conciseness, crispness, precision and clarity of language
5 -- Oct. 8	Communications #3 • Sketching practice • Biomimicry case studies • Sust. workshop • Oral presentations • Slide Design • [LP #3]			<ul style="list-style-type: none"> • Produce introductory engineering drawings and sketches • Produce introductory technical reports • Interpret ethical, social and environmental influences • Impact of engineering on society

[...]" enrichment material

Engg 200 Fall 2012: Paper project plan

Week	Comms Lecture	Workshop/Lab	Due	Learning Outcomes
1 -- Sept. 10		3 hours: "Icebreaker" 1. An introduction to the communications component of the course 2. An introduction to logbooks 3. An introduction to technical communication. This introduction is similar to reverse engineering. Students are asked to analyze a document 4. An introduction to graphics in this course	Logbook check by TAs at end of lab [Participation mark - in lab]	<ul style="list-style-type: none"> • Individual and team work • Produce introductory engineering drawings and sketches • Impact of engineering on society • Construct logical and persuasive arguments
2 -- Sept. 17	Communications #1 • Introduction to paper project & components • Introduction to Biomimicry Design Process • [LP #1]* • Sketching practice • Sust. workshop			<ul style="list-style-type: none"> • Produce introductory engineering drawings and sketches • The impact of engineering on the environment • Interpret ethical, social and environmental influences • Elicit and interpret customer needs
3 -- Sept. 24		1 hour comms portion: Introduction to sketching 2 Introduction to Inventor	Logbook check by TAs @ end of lab [- in lab]	<ul style="list-style-type: none"> • Produce introductory engineering drawings and sketches • Produce introductory CAD drawings of designs

[...]" enrichment material

Engg 200 Fall 2012: Paper project plan

Week	Comms Lecture	Workshop/Lab	Due	Learning Outcomes
6 -- Oct. 15	Communications #4 • Sketching practice • Sust. workshop • [LP #4]			<ul style="list-style-type: none"> • Produce introductory engineering drawings and sketches • Produce introductory technical reports • Interpret ethical, social and environmental influences • Impact of engineering on society
7 -- Oct. 22		Paper project work • Executive Summary work • Autodesk Inventor time • Oral presentations	<ul style="list-style-type: none"> • Executive Summary draft - one per team member - collect • Logbook check by TAs @ end of lab 	<ul style="list-style-type: none"> • Give group presentation • Produce introductory CAD drawings of designs • Produce introductory technical reports • Work effectively in a small team • Describe and apply techniques for creative problem-solving
8 -- Oct 29		Paper project work	<ul style="list-style-type: none"> • Draft report: Abstract, Exec. Summary, Concept sketches, Design Process, Model, LP evaluation, Autodesk Sust. Part • Logbook check by TAs @ end of lab 	<ul style="list-style-type: none"> • Produce introductory engineering drawings and sketches • Produce introductory technical reports • Interpret ethical, social and environmental influences • Impact of engineering on society • Work effectively in a small team • Describe and apply techniques for creative problem-solving

[...]" enrichment material

Engg 200 Fall 2012: Paper project plan

Week	Comms Lecture	Workshop/Lab	Due	Learning Outcomes
9 -- Nov. 5	Communication #5 • Sketching practice • Report writing 1		<ul style="list-style-type: none"> • Paper project due in lab (on CD) • Abstract • Executive Summary • Concept Sketches (may include story boards, flow charts, etc.) • Final Sketch Rendering or Model • Presentation — A maximum of 12 slides • Evaluation According to Nature's Principles • Optional Autodesk Sustainability Workshop Award presentation 	<ul style="list-style-type: none"> • Produce introductory engineering drawings and sketches • Produce introductory technical reports • Interpret ethical, social and environmental influences • Impact of engineering on society • Work effectively in a small team • Describe and apply techniques for creative problem-solving • Ability to complete basic analysis with respect to the impact of engineering on the environment, and on social, knowledge and economic systems in modern culture
10 -- Nov. 12				
11 -- Nov. 19	Communication #6 • Sketching practice • Report writing 2			<ul style="list-style-type: none"> • Produce introductory engineering drawings and sketches

[...]" enrichment material

Fig. 6. Fall 2012 paper project plan.