

Beyond Engineering: Lessons From Concept Maps & Value-Added Labs

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Introduction

There is often a difference between what the professor intends to convey about a subject and what the students actually take away. Professors often do student evaluations in the forms of tests, homework assignments, and surveys. One way to evaluate is to have them create concept maps. A concept map is a visually connected summary of the main terms used throughout a course.

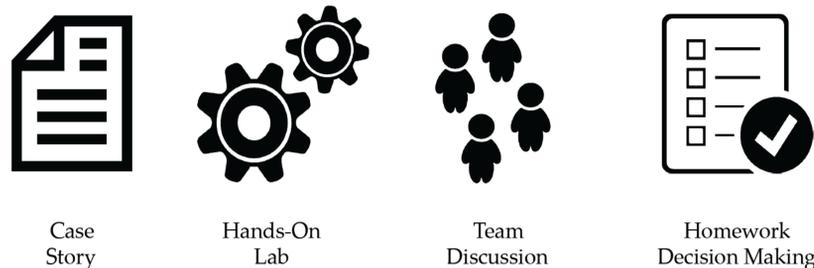


Figure 1. Kolb's experiential learning theory

Kolb's experiential learning theory (Figure 1) asserts that the learning experience can be enhanced by engaging the material from multiple angles. We set out to use what we learned from concept maps to improve the E14 bike lab.

Methods

We made consistent iterations of the bike lab until students were able to get a full learning experience.



Figure 2. Students work on bike lab

Carefully constructed personas were illustrated and described in ways that students could easily relate.

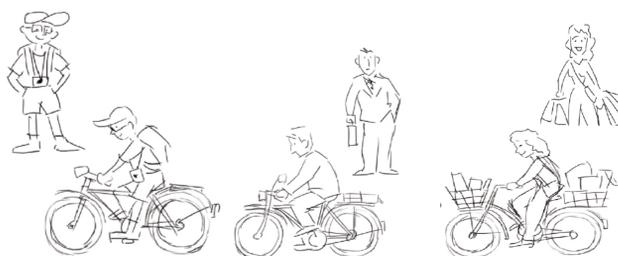


Figure 3. Illustrated personas of the tourist, commuter, and shopper

Results

From the data, we formed a concept map that summarized the perspectives of the students. The map (Figure 4) exposed some strengths of the class (structure and analysis) and some areas that could be emphasized more (moments).

In order to encode the data, we assigned point values to the terms as follows:

- 4 points for the Center Term
- 2 points for Level Two
- 1 point for Level Three

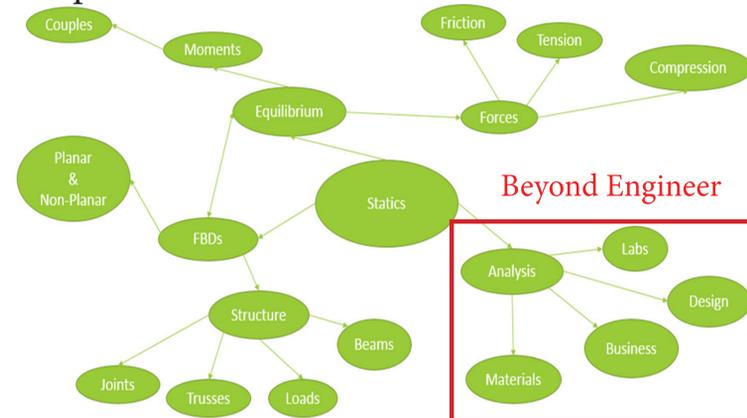


Figure 4. The derived class concept map from the data

We were able to identify the "beyond engineer" region of the concept map (red square) and apply it to the bike lab. Students used empathy (Figure 5) to choose which persona to cater to.

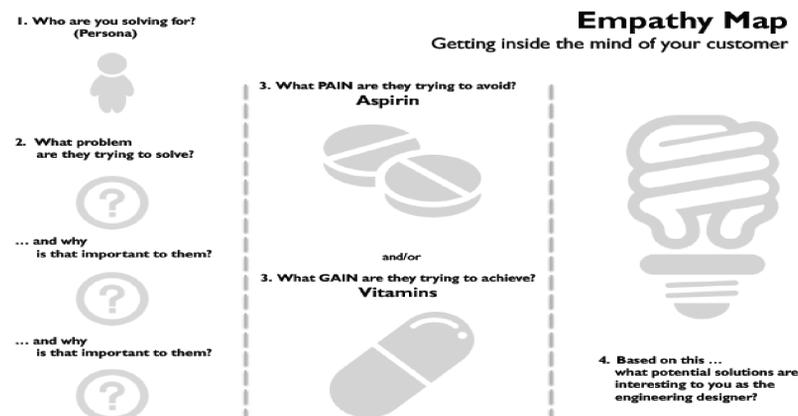


Figure 5. Students used this empathy map to connect with the customer

Literature Cited

- Turns, J. (2000). Concept Maps for Engineering Education: A Cognitively Motivated Tool Supporting Varied Assessment Functions. *IEEE Transactions On Education*, 164-173.
- Kolb, D. (1984). *Experiential learning: experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall.

Conclusions

Through value-added labs, students were able to gain a memorable experience through experiential learning.

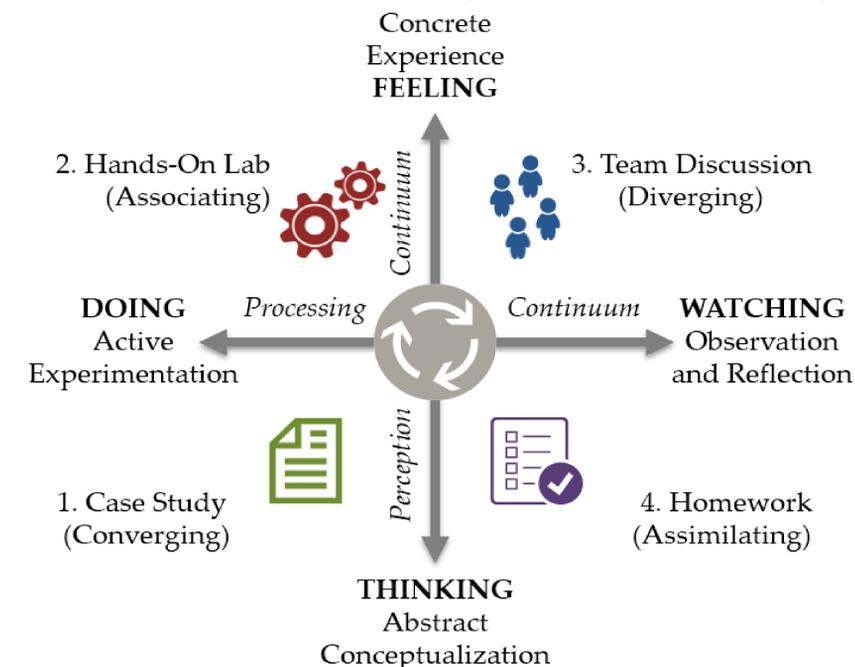


Figure 2. Kolb's case method elements



Case Story

Students are given a case study that in which engineers at bicycle company Trek are deciding how to implement their new B-cycle program. They must decide to cater to one of three personas.

Students go hands-on in teams in order to figure out the anatomy of a bike and learn more about mechanical advantage. They are able to feel and experience how the product works.



Hands-On Lab



Team Discussion

By working and discussing with teammates, students learn what it is like to work on an engineering team. They also see the issues from many perspectives as they come to their final decision.

A key part of engineering, both professionally and academically, is learning to think beyond the numbers. After the in-class activities, students now use this knowledge to choose a persona.



Homework Decision Making

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Next Steps

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