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WIP: Faculty Use of Metaphors When Discussing Assessment

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Abstract

This Work-in-Progress paper studies the mental models of engineering faculty regarding assessment, focusing on their use of metaphors. Assessments are crucial components in courses as they serve various purposes in the learning and teaching process, such as gauging student learning, evaluating instructors and course design, and documenting learning for accountability. Thus, when it comes to faculty development on teaching, assessments should consistently be considered while discussing pedagogical improvements. To contribute to faculty development research, our study illuminates several metaphors engineering faculty use to discuss assessment concepts and knowledge. This paper helps to answer the research question: which metaphors do faculty use when talking about assessment in their classrooms? Through interviews grounded in mental model theory, six metaphors emerged: (1) cooking, (2) playing golf, (3) driving a car, (4) coaching football, (5) blood tests, (6) and generically playing a sport or an instrument. Two important takeaways stemmed from the analysis. First, these metaphors were experiences commonly portrayed in the culture in which the study took place. This is important to note for someone working in faculty development as these metaphors may create communication challenges. Second, the mental model approach showed potential in eliciting ways engineering faculty describe and discuss assessments, offering opportunities for future research and practice in faculty development. The lightning talk will present further details on the findings.

Background

To understand the utility of metaphors in a given intellectual or cultural context, it is important to first understand how metaphors might be being used. To that end, we examined the metaphors that emerged during interviews with faculty about assessments. Research shows that metaphors can be both helpful and harmful ways to represent ideas in learning environments. One way metaphors are helpful is that they can offer ways to help learners visualize concepts or ideas that are hard to understand, such as students using metaphors frequently to illuminate their understanding [1]. Literature has also documented other benefits, such as learning creative design [2], software engineering communication [3], and sustainability [4]. However, analogies and metaphors can also be harmful in learning environments. For example, the "pipeline" metaphor has been criticized as a way to represent the need for increasing diversity in engineering and other STEM fields because it suggests a monolithic pathway into and through engineering [5] that can limit ways of thinking about this phenomenon. Metaphors can also be harmful when they are assumed to represent knowledge that is perceived to be shared, but in reality is not. Metaphors are cultural in their origin [6] and can have more or less meaning to different groups of people and therefore have different utility as learning tools [7].

Methods

We employed a qualitative interview study design to code and make meanings of the assessment metaphors [8] [9] [10]. The data collected are part of the larger NSF-funded study that focuses on understanding engineering faculty assessment mental models and decision-making, with purposeful sampling. 28 interviews were collected and transcribed. Interview participants were faculty members in various engineering disciplines and types of institutions. The interview protocol focused on their views, perspectives, and actions on assessments, with questions stemming from a mental model theoretical framework [11]. Out of the 28 interviews, 5 participants invoked metaphors to discuss and explain their views on assessments. It must be noted that the interview protocol did not ask for metaphors while discussing assessments, so these metaphors emerged voluntarily. We then employed qualitative coding for meaning making and abstracting to the type of metaphors being discussed [10], leading to six metaphors identified.

Results

Analysis yielded 6 metaphor types (Table 1). To exemplify their usage, we illuminate the "driving a car" metaphor. A participant used this metaphor more than half a dozen times to discuss different aspects of assessments. First, this metaphor was used when asking about their definition of assessment.

> *"...using this analogy, driving a car, I would like someone to be able to start the car, and drive around town, and do a couple basic tasks, without hurting someone, without hurting themselves..."*

By using this metaphor, we can see that this participant used assessment to assess whether or not students can perform a desired task, as opposed to, for example, assessing student understanding or knowledge.

The participant then used the metaphor multiple times when explaining how they created their test questions.

> *"Whether this particular aspect of a problem, I focused enough or not, that will reflect my current lecture. Did I pay too much attention in this? Again, this is like driving a car, so we can spend a lot of time driving a car, but then, did we do enough left turns to say [...].The exam will be a left turn. Did we do enough parking practice? Okay. Now it's going to be part of the practice."*

> *"My exam will be part of the parking. It will not be the same spot where we do the homework, and it will not be maybe with the same car, with the same traffic around it."*

Finally, along with creating tests, the participant used this metaphor when describing how they graded tests and their grading philosophies,

> *"Doing half of the process correct is not really good. [...] To go to the driving analogy, you started the car, but then you started in reverse. Maybe you hit something on your way. I will give you partial credit for, okay, so you know where your turn signal is, you know where your gas pedal is, but if you cannot drive without hitting something, you have not demonstrated full competence."*

> *"Secondly, I don't think that a student should be gauged against someone else. [...] But curving the class would be that you drove downtown, and you hit two people, but because everybody else hit five people, now you're getting an A. No. There's an absolute level of competence that you should demonstrate before I can give you a driver's license."*

Table 1: Types of Metaphors Used by Engineering Faculty Discussing Assessment

Metaphor Type	Example Quote
Cooking	*"Labs are much more of a recipe. So I would say you can equate this a little bit to maybe cooking. I have cookbooks. I can go and take a cookbook. I can follow the recipe and I can make a very nice meal, but I am not the person who's going to, let's say, something difficult, a souffle. There's no way I can from my brain, come up with the recipe for a souffle, because I don't have the background, the pastry knowledge for that to come up with how much flour versus baking powder. I don't know whatever's in a souffle, I don't even know. But to execute on a recipe or a protocol does not require the same knowledge as the theory, understanding the theory."*
Playing Golf	*"You can play Wii all the time. But if I give you the real golf stick, and you can't swing that golf stick, it's useless."*
Driving a Car	*"... using this analogy, driving a car, I would like someone to be able to start the car, and drive around town, and do a couple basic tasks, without hurting someone, without hurting themselves. That's the analogy. In the courses I'm teaching"*
Coaching Football	*"... the model that I used to describe that is like, if this is a football team, I'm the coach. The coach, the team does not play against the coach, the coach prepares the team. Now the team has to play against someone else. That's their assessment. But, that's not how it really works with teaching. So, I'm both the coach, and the opposing team, the same."*
Blood Tests	*"...the exam for me is like a blood test. You do a blood test, and it tells you you have high cholesterol, and now you need to do something. So, this is a diagnostic, especially for the students who did not do well. [...] It tells you that there's something that you need to take care of, and there is a way to fix it."*
Generically Playing Sport/Instrument	*"My personal philosophy has been to use the analogy to you want to learn a sport or you want to learn to play the piano, you have to practice. So a good amount."*

Discussion and Implication

This work was in the context of a study about mental models of assessment. Metaphors and mental models are closely related in that they both reflect the way people think about and understand concepts, ideas, and experiences. By using metaphors, people can make complex concepts more understandable and memorable, and by reflecting on the metaphors they use about assessment, the research and faculty development communities can gain insights into the mental models that faculty members have constructed and how to help improve them over time.

However, when using metaphors, it is important to understand their limitations. Individuals need to be cognizant of who their metaphor is accessible to, and a big factor of metaphor accessibility is culture. In our study, participants used sport metaphors for golf and football. However, this metaphor may not be accessible to individuals who did not grow up or live in the United States. Even those who know about the concept of football and golf may not know the details of the sports, and thus not understand what is trying to be conveyed with the metaphor. Not understanding the metaphor can lead some individuals to tune out, which can hinder the authenticity of the conversation and prohibit effective communication.

Another limitation of metaphors is their accuracy. While metaphors can be an effective tool to help relate unknown ideas to known ideas, it can also be harmful if incorrect or ambiguous metaphors are used. Incorrect and ambiguous metaphors can lead to misunderstandings or inaccurate knowledge of the new idea or concept. For example, in our study, when one participant used the driving metaphor to discuss how they created exams, they related exam questions to parking by stating that the exam will be on parking but not in the same spot or environment as the homework. This could be construed as ambiguous. One individual may take that literally, thinking the exam environment is not the same as the homework environment, while another individual might take that to mean the types of problems will be a slightly different format than the homework questions. Not having clear and accurate metaphors can cause miscommunication, and result in thinking one has a better understanding, when in reality there is a misunderstanding. Metaphors can be an effective tool to aid understanding when communicating new ideas to someone, but only if used correctly. It is therefore important to know your audience when choosing a metaphor, and to make sure the metaphor is clear and accurate.

Acknowledgements

References

[1] N. P. Pitterson, N. Perova-Mello, and R. A. Streveler, "Engineering Students' Use of Analogies and Metaphors: Implications for Educators," *Int J Eng Educ*, vol. 35, pp. 2-14. 2018.

[2] J. Hey, J. Linsey, A. M. Agogino, and K. L. Wood, "Analogies and Metaphors in Creative Design," *Int J Eng Educ*, vol. 24, no. 2, pp. 283-294. 2008.

[3] C. Keen, "Treatment of metaphors in software engineering education," in *Proceedings 1996 International Conference Software Engineering: Education and Practice*, Jan. 1996, pp. 329–335. doi: 10.1109/SEEP.1996.534018.

[4] A. Carew and C. Mitchell, "Metaphors used by some engineering academics in Australia for understanding and explaining sustainability," *Environmental Education Research*, vol. 12, pp. 217020217–15, May 2006, doi: 10.1080/13504620600690795.

[5] A. L. Pawley, J. Hoegh, "Exploding pipelines: Mythological metaphors structuring diversity-oriented engineering education research agendas," in *ASEE Annual Conference & Exposition*, (June) 2011, pp. 22-684.

[6] Z. Kovecses, "Metaphor and culture," *Acta Universitatis Sapientiae*, *Philologica,* vol. 2, no. 2, pp. 197-220, 2010.

[7] M. G. A. Hewson and D. Hamlyn, "Cultural Metaphors: Some Implications for Science Education," *Anthropology & Education Quarterly*, vol. 16, no. 1, pp. 31–46, 1985, doi: 10.1525/aeq.1985.16.1.05x0849q.

[8] W. C. Adams, "Conducting Semi-Structured Interviews," in *Handbook of Practical Program Evaluation,* 4th ed., John Wiley & Sons, 2015, pp. 492-505.

[9] S. Kvale, "Ten standard objections to qualitative research interviews," *Journal of Phenomelogical Psychology,* vol. 25, no. 2, pp. 147-173, 1994.

[10] M. B. Miles, A. M., J. Saldana, in Qualitative data analysis: A methods sourcebook, 3rd ed., Sage Publications, 2014.

[11] P. N. Johnson-Laird, "Mental models and human reasoning," Proc. Natl. Acad. Sci. U. S. A., vol. 107, no. 43, pp. 18243–18250, 2010, doi: 10.1073/pnas.1012933107.