122nd ASEE Annual Conference & Exposition
June 14 - 17, 2015
Seattle, WA
Paper ID #11775

Does Motivation Matter for Conceptual Change: Developing Effective Qualitative Research Approaches

Dr. Holly M Matusovich, Virginia Tech

Dr. Matusovich is an Assistant Professor and Assistant Department Head for Graduate Programs in Virginia Tech's Department of Engineering Education. She has her doctorate in Engineering Education and her strengths include qualitative and mixed methods research study design and implementation. She is/was PI/Co-PI on 8 funded research projects including a CAREER grant. She has won several Virginia Tech awards including a Dean's Award for Outstanding New Faculty. Her research expertise includes using motivation and related frameworks to study student engagement in learning, recruitment and retention in engineering programs and careers, faculty teaching practices and intersections of motivation and learning strategies. Matusovich has authored a book chapter, 10 journal manuscripts and more than 50 conference papers.

Dr. Rachel E McCord, University of Tennessee, Knoxville

Rachel McCord is a a Lecturer in the Engineering Fundamentals Division at the University of Tennessee in Knoxville. She received her Ph.D. in Engineering Education from Virginia Tech. Her research interests include the impact of metacognitive and self-regulated learning development on engineering student success, particularly in the first year.

Dr. Cheryl Carrico, Virginia Tech

Cheryl Carrico is a Postdoctoral Research faculty member for Virginia Tech. Her current research focus relates to STEM career pathways (K-12 through early career) and conceptual understanding of core engineering principles. Prior to her current role, Dr. Carrico spent over 25 years in the aerospace industry conducting and leading R&D, design engineering, and project management for composite aircraft components. Dr. Carrico received her B.S. in chemical engineering from Virginia Tech, Masters of Engineering from North Carolina State University, MBA from King University, and PhD in Engineering Education from Virginia Tech. Dr. Carrico is a certified project management professional (PMP) and licensed professional engineer (P.E.).

Danielle Almetria Smalls, Virginia Tech Engineering Department
Mr. Philip Reid Brown, Virginia Tech Department of Engineering Education

Philip Brown is a PhD candidate in the Department of Engineering Education at Virgnia Tech. His research interests include the use of motivation, cognition and learning theories in engineering education research and practice, and better understanding student perspectives in engineering programs.

Does Motivation Matter for Conceptual Change: Developing Effective Qualitative Research Approaches

Abstract
Amidst the growing spectrum of research focused on understanding the cognitive and motivational factors that impact how students learn, the field of engineering education lacks sound research on the methodological approaches used to study these complex constructs. The current study was intended to highlight some of the current concerns in studying complex ideas through the use of qualitative methodologies. This research lays a foundation for future work by helping us determine what questions to ask participants and how to ask them in order to tease apart their motivational beliefs and learning strategies for specific content-related problem solving. Recommendations include interviewer training on how to ask follow-up questions to motivation-related utterances.

Introduction

Despite considerable research in engineering education, there is still much to uncover with regard to how students learn, what they learn, and why they learn it. While there is a wealth of data on cognition, metacognition, and teaching strategies (all examples of the how), and misconceptions, conceptual change, and curriculum development (all examples of the what), motivation (example of the why) still remains understudied by comparison. Epistemologically sound qualitative research approaches to study complex learning and motivation interactions are likewise underrepresented in engineering education research[1]. As part of a larger study to understand motivation and conceptual understanding, our current analysis sits at the intersection of the underrepresented topics of motivation for learning difficult concepts and qualitative modes of research. The purpose of our research was to answer the question: How can clinical interview methods elicit both conceptual understanding of engineering concepts and motivation towards learning such concepts? We focused on clinical interview approaches because they are popular modes for examining students' conceptual knowledge[2], yet their utility in simultaneously uncovering motivation is not established.

Drawing on a theoretical framework for intentional conceptual change[3], we qualitatively analyzed two different clinical interview approaches to answer our research question. In the first approach, existing clinical interviews, in which the participants were NOT specifically asked questions about motivation, were analyzed with the intent of uncovering the "organic" utterances related to motivation emergent in student self-talk during problem solving; we used open coding of the data to reveal instances of unprompted motivation-related utterances. In the second approach, participants were asked to think aloud while solving a problem and discuss the learning strategies in which they engage. In this second approach, multiple questions drawing on existing motivation constructs (e.g., interest, efficacy, and values) were asked during these think-aloud interviews, enabling us to use *a priori* coding to focus analysis on specific motivation constructs. In our results, we compare the two interview/analysis approaches with regard to what each reveals about student motivation towards learning concepts in engineering disciplines.

Literature Review

To situate our study, we draw on two bodies of literature. The first area we consider is literature on clinical interviews and we briefly described the purpose and methods of such an interview

approach. The second area of literature we consider is theories on motivation and we briefly justify why we believe clinical interviews could be useful for revealing student motivation for learning concepts in engineering disciplines.

Clinical Interviews

Clinical interviews have a rich history in research on conceptual understanding. Posner and Gertzog[4] suggested that the chief goal of clinical interviewing is "to ascertain the nature and extent of an individual's knowledge about a particular domain by identifying the relevant conceptions he or she holds and the perceived relationships among those conceptions" (page 195). They argue that the method is appropriate because it is "highly flexible, allowing a skillful researcher both to probe the areas of the knowledge domain of particular interest and to let the subject speak freely, while constantly checking his or her spontaneous remarks for those that will prove genuinely revealing" (page 195). Clinical interviewing should not be confused with think-aloud protocols. In a think-aloud protocol, participants are asked to solve a problem while articulating their thought process[5]. While seemingly similar to a clinical interview, the think-aloud protocol does not include probing questions and instead prompts are mainly focused on reminding participants to verbalize his or her thoughts[5]. For example, if the participant is working but not speaking, the interviewer might say, "So tell me what you are thinking while you are working." In comparison, a clinical interview would probe for clarification and ask why the participant is doing what he or she is doing.

According to Russ, Lee, and Sherin[6], clinical interviews have been used in topics related to understanding how students think, influencing curricular reforms, and designing learning environments. Russ et al.[6] suggest that the clinical interview is popular in such a wide range of research topics because it is semi-structured with room for improvisation on the part of the researcher, allowing for potentially deeper exploration of relevant contexts than other, more structured methods. This explains the rationale behind the use of clinical interviews to examine how students are thinking about different STEM topics, from cognitive development in math[7] to the role of prior knowledge in understanding special relativity[8] to conceptual understanding in topics in engineering[2,9-11]. These studies focused on how students understand information in STEM topics. We argue that, given the broader history of clinical interviewing as a method for studying cognition, clinical interviews could also be put to valid use in studying motivation in relation to cognitive processes.

Motivation and Learning

The topic of motivation is broad and varied in theory and research. Instead of thinking of motivation as a single idea, it can instead be more helpful to consider it a family of interconnected ideas, each with its own set of theories and constructs. In an overview of motivation theories, Eccles and Wigfield[12] group them into four categories. The first are theories of expectancy, which concern personal beliefs about one's own ability to perform tasks and the perceived difficulty of tasks. The second are reasons for engagement, which encompass beliefs and values that individuals consider when choosing to participate in a task. The third is the integration of expectancy and value, which concerns the connection between beliefs of expectancy, other personal values, and beliefs. The fourth is the integration of motivation and cognition, which tie motivation-related concepts directly to cognitive function and learning. For this paper, we are most concerned with the latter group of motivation theories, how motivation

has been tied to learning in the past, and how the intersection of motivation and learning could be accessed through the clinical interview research method.

Theories that look at the intersection of motivation and cognition include self-regulation[13,14] and the theory of intentional conceptual change[3], which guides our overarching study. While these theories differ in the type of motivation-related constructs they examine and how they relate to cognition, within each framework motivation, cognition, and learning are interconnected. For example, the core of the model for intentional conceptual change is the idea that a student's motivation for conceptual change will shape the way they approach learning. This model starts with a primary categorization of students' motivation under *Achievement Goals* (e.g., mastery, performance) then considers *Other Motivational Beliefs* (e.g., interest, self-efficacy) and the associated *Learning Strategies* (e.g., cognition and metacognition) as contributing to *Intentional Conceptual Change*. Models such as this demonstrate the identified connection between motivation and cognition. We believe this warrants the investigation of clinical interviews because they have been shown to be a valid method for studying cognition in context and could provide similar insight into the contextual role of motivation in cognition in context.

Methods

With the purpose of examining ways of eliciting evidence of motivation in clinical interviews, this study is a purely qualitative secondary analysis of existing interview data[15]. We adopted a multi-case study approach[16,17] and considered each separate interview to be a case. The data used in the broader analysis were collected as part of a series of NSF-funded studies related to conceptual understanding across multiple engineering disciplines; the purpose of combining studies was to share data and develop analysis approaches that enable breaking down the disciplinary boundaries to better understand conceptual change[18]. In this specific analysis, we draw on examples from two sets of interviews and existing analysis results to examine the usefulness of interviews in revealing insights into student motivation for learning difficult concepts. All interviews were conducted at points in the curricula after students would have been exposed to the concepts.

Interview Set 1: Data and Analysis

Four interviews were chosen from a larger set of interviews on mechanics of materials[2,10,19-22] to represent cases of "high" or "low" conceptual understanding evidenced by participants. The mechanics of materials study involved a series of questions related to strains and stresses on two-dimensional objects. Occasionally, participants were prompted to illustrate stress or strain on a 3-dimensional object, like a rubber band, to show their conceptual understanding. The final question of the problem set was a contextualized "real-world" problem regarding concrete failure.

The interviews were originally analyzed with the intention of examining organic motivation utterances as participants were not directly asked about motivation. Starting with our model for intentional conceptual change, different possibilities for potential utterances were anticipated. For example, we looked to the theoretical framework for examples of what an *interest* statement would look like and how it might be operationalized in our study (i.e., "These are my favorite problems to solve because they're fascinating."). We did the same for value beliefs. We conceptualized self-efficacy even more broadly to encompass competence beliefs more

generally. With an idea of what utterances might look like, we used open coding of the data to reveal instances of unprompted self-talk or motivational utterances, which were compared by the researchers after several coding sessions[23]. Similar utterances were categorized into themes.

Interview Set 2: Data and Analysis

The second set of interviews included clinical type interviews with seven participants regarding heat transfer. To investigate learning strategies, participants were asked about how they approach different learning settings, and were then directly asked some motivation questions (e.g., How interesting is the content of the class?). Finally they were asked to solve a conceptual problem while the interviewer probed for understanding and motivation. Because motivation constructs from the intentional conceptual change model were used to design the questions, these constructs became the *a priori* codes applied to the interviews. For each transcript, segments of the text that demonstrated the participants' motivation were assigned a code based on the definition of the motivation construct from the literature. After a transcript was completely coded, the researcher interpreted the level of motivation for each motivation construct and assigned a rating (e.g., high or low). The researcher provided comments to explain why the rating was chosen. Interpretation was based on coded segments as well as overall interview context.

Combined Analysis

Rather than focusing on the identified motivation constructs themselves, we focused on the ways motivation emerged in the analysis. We used the coding from the initial data sets but examined them broadly for what they could tell us about how effectively the clinical interviews revealed insights into student motivation for learning concepts in engineering.

Results and Discussion

Looking across the patterns in findings from both prior analyses, we identified several new findings. In this paper, we are deviating from the normal pattern of presenting all results followed by discussion. Because we are referring to multiple findings from multiple sets of interviews, we believe the reading experience is made easier and more cohesive by offering a discussion immediately after each finding.

Unintentional Influences on Participant Motivation

In both interview formats, interviewers can unintentionally influence student motivation. These influences happened in at least two ways. Interviewers can change the freedom of information flow of student responses based on how the interviewer responds to what the participant says. Consider an example from the mechanics of materials interviews. In one case a participant seemed very comfortable reasoning his or her way through a problem whether he was certain of the outcome or not. However, when specifically asked about an uncertainty of a stress distribution on an element and if the respondent had any guesses, the result was a short answer that essentially terminated the probing:

> Interviewer: Go to the next page. On this strain element here that we represented before, now this time, draw the stresses that are acting on this cross section. What's that distribution going to look like on that space?
> Respondent: I am not sure.
> Interviewer: How so? What are you not sure about?

Respondent: What it would look like.
Interviewer: Any guesses; any reasoning for how it might look?
Respondent: Not off the top of my head.

In this example, when the participant's knowledge was challenged, the participant changed to a mode of protecting the self where a further display of a lack of knowledge, competence, or ability could be minimized. Boekarts[24] adaptable learning model might describe this as switching from a mastery mode to a coping mode. Boekarts[24] suggests that learners adopt learning modes based on appraisals of the self and situation. Evidence of this switching has been found in engineering students studying in groups[25] and may likewise extend to interview situations.

Drawing from the second set of interviews, the interviewer responded to a participant's answer by saying, "That's a very interesting response. Yeah, that's really interesting. I have never thought about that before." This prompted the participant to continue the explanation. In an attempt to build rapport, the interviewer actually used a motivation construct in a form of encouragement. In Social Cognitive Theory, Bandura[26] suggests that one way self-efficacy can be built is through the feedback from a valued other. It is possible that the interviewer is perceived as a valued other, as a content expert, and expressions of interest could build self-efficacy to proceed.

In both of these examples, the interviewer was intending to solicit additional information from the participant. In doing so, they may also have influenced the participant's motivation with regard to answering interview questions—negatively in the first case and positively in the second case. Our intention was to look at motivation for conceptual understanding in a given topic area, and we learned that over the course of a clinical interview, it can become difficult to separate motivation for the task at hand (the interview) from the motivation to engage in a content area (heat transfer or mechanics of materials). This is perhaps not surprising when considering that a similar limitation has been suggested in using clinical interviews for cognitive processes. For instance, Posner and Gertzog[4] suggest one significant limitation in using clinical interviews to assess conceptual understanding is the potential to misinterpret participant responses and potentially confuse spontaneous statements with convictions. In the implications section, we discuss potential remedies for this limitation.

Context and Lack of Construct Specificity

When participants were not directly asked about motivation, interpreting participant motivation was difficult because the context for the motivation statement was often ambiguous and participants rarely used language consistent with theoretical constructs. Although we carefully examined the first data for utterances relative to interest, value, and competence beliefs and used the most unrestricted definitions for these constructs possible, the only consistently represented motivation construct was competence beliefs, though even this was hard to separate by theoretical construct. Statements relative to interest were both rare and ambiguous. For example, it was not clear if it was the task or interview setting that was interesting or if they were just common speech utterances designed to move the conversation forward. One participant said, "I like the truck examples, but I guess regardless of any vehicle, it takes time to get started up." The interest expressed here could be about the interview process where truck examples were selected or simply the truck examples themselves. Value statements were essentially absent from the first interview set altogether[27].

Because participants rarely use the language of theoretical constructs, prevalent competence beliefs are difficult to parse into theories for meaningful explanations (i.e., it is difficult to know if asking about a "right answer" is performance orientation or striving to demonstrate competence). For example, when asked to explain an answer, respondents sometimes asked clarifying questions. When asked to further explain what appeared to be a vague answer, one participant asked the interviewer "what do you mean" several times. From the context of the interview, it is unclear if the participant was "fishing" for information to help answer the question correctly or if the participant was trying to understand the question. Because participants tended not to explain why they were asking such questions, the student motivation is not obvious. The fact that the theoretical motivation constructs are hard to express in everyday language is a critique of motivation theories that led to the creation of the MUSIC Model of Academic Motivation[28] which draws on common language.

Moreover, the actual setting of the interviews can perhaps influence a performance goal orientation. In the following exchange, the participant seems to be using the context to help form solution strategies:

> Interviewer: Okay. And why did you all of a sudden realize that there was shear there?
> Respondent: Well, I figured you wouldn't be asking this unless there was shear. So --
> Interviewer: Okay.
> Respondent: -- that's pretty much it. Like I said, I'm trying to remember the rules for shear stress right now, but I'm not remembering too much.

In this excerpt, the participant is unsure of the answer but uses the situation to try and help get the right answer. As discussed in the previous section, the switching of interviewee responses to a performance mode could be interpreted as consistent with adaptable learning[14], or self-monitoring of self-efficacy[26].

It is Difficult to Ask Specifically About Motivation

In the second dataset, we attempted to correct for challenges in the first dataset by directly asking about motivation. We found this to be equally challenging because motivation constructs can become confounded with each other, themselves, and the context. Consider this interview excerpt:

> Interviewer: So did you find the content interesting in thermodynamics?
>
> Participant: …So we took thermo 1 and thermo 2 and thermo 1 was basically the 3 equations: Mass, energy, entropy balance. That's all we did. And then thermo 2 was, like, phase compositions, kinetics, and then random topics that apply to thermo, like electrolytic solution, partition in the environment. And I felt like thermo 1 was.. I liked it a lot because it was very mathematical. It was very dry. It was very… Like, everything came from proofs and it was cool and I liked that, but it didn't apply as much to situations that I could see. And thermo 2 was the opposite. Thermo 2 I really couldn't follow the math. I felt like the teacher just sort of told us like, "by the way, like, here the DH equation for electrolyte solutions." But I felt like thermo 2 was much more practical. It had a lot more interesting applications, which thermo 1 did not have at first.

In this excerpt, the participant indicates liking "thermo 1" but also calls it dry. These seem like contradictory expressions of interest. The participant also includes a value statement in saying that he or she did not see how learning could be applied. In contrast, "thermo 2" was difficult to understand yet seemed to be more "practical" with "interesting applications." A seemingly straight forward question about interest results in a complex answer using words and expressions that reflect motivation constructs generally without direct statements. The one statement using a construct says the applications were interesting, but not the course.

Implications and Conclusions

Our findings demonstrated that each clinical interview approach was problematic for revealing motivation for conceptual understanding; in both cases, the interview context and dialog are critically important and can directly shape motivation. While problem solving interviews offer a window into the mind of the problem solver, we must recall that it is still a social activity where the interviewer and interviewee are engaged in a dialog and react to each other. Specifically with regard to motivation, our findings suggest interviewers can unintentionally impact participant motivation, and participant motivation can be difficult to discern when looking at organic utterances or specific questions about motivation. As a result, researchers must be careful in interpreting expressions of motivation from the interviews regardless of the way questions are asked or not asked.

As previously noted, this limitation in interpretation is similar to the cited limitation of clinical interviews being used for assessing conceptual understanding where spontaneous statements in the interview must not be confused with actual convictions. For clinical interviewing to assess cognition, two considerations are suggested to combat this difficulty. The first is the use of well-trained interviewers who have developed skills though "conscious effort over an extended period of time"[4] (page 198). The second is to remain aware of the possibility that subjects were led in their cognitive process throughout data analysis. Echoing this limitation, we found that the motivation of participants could be influenced by the interview process. In addition to appropriate and significant training, we recommend directly asking about motives in the interview in addition to motivation constructs more broadly. For instance, in our earlier examples regarding not understanding the participant's motive for asking for clarification, the participant could be directly asked, "Why do you ask?" This could offer insight into the difference between interview motivation (e.g., adaptable learning, self-efficacy) versus more general motivation towards learning. We tried such an approach at the very end of several interviews when participants were asked if they wanted to know the right answer:

> Interviewer: Do you want to know what the right answer is?
> Respondent: Yes, please.
> Interviewer: Before I give it to you, can you tell me why do you want to know what the right answer is?
> Respondent: To have some positive output of the thought I just put into this.

However, even in these cases, additional follow-up questions would be needed to explicate the in-the-moment motivation from motivation convictions.

In conclusion, we believe clinical interviewing can be used to evaluate intersections of motivation and cognition. The approach is not without methodological challenges, but we

believe that these can be overcome using approaches similar to those suggested for addressing limitations to the use of clinical interviews to assess cognitive understanding alone. As a result of this research, we will conduct further clinical interviews with a blend of asking participants why they are doing what they are doing and intentional prompts directly related to motivation in an effort to improve our ability to tease out motivational beliefs and learning strategies for specific content-related problem solving.

Acknowledgements

This paper is based on research supported by the National Science Foundation under Grant Nos. EEC-1150384, 1129460, 1129474, 1129447. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

We also thank our participants and the faculty who helped us locate potential participants. We also thank Tina Siemetz who helped with data analysis.

References

[1] Case, J. M., & Light, G. (2011). Emerging Methodologies in Engineering Education Research. *Journal of Engineering Education, 100*(1), 186-210.

[2] Montfort, D., Brown, S., & Pollock, D. (2009). An Investigation of Students' Conceptual Understanding in Related Sophomore to Graduate-Level Engineering and Mechanics Courses. *Journal of Engineering Education, 98*(2), 111-129.

[3] Linnenbrink, E. A., & Pintrich, P. R. (2003). Achievement goals and intentional conceptual change. In G. M. Sinatra & P. R. Pintrich (Eds.), *Intentional conceptual change* (pp. 347–374). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

[4] Posner, G. J., & Gertzog, W. A. (1982). The clinical interview and the measurement of conceptual change. *Science Education, 66*(2), 195-209. doi: 10.1002/sce.3730660206

[5] Van Someren, M. W., Barnard, Y. F., & Sandberg, J. A. *The think aloud method: A practical guide to modelling cognitive processes* (Vol. 2).

[6] Russ, R. S., Lee, V. R., & Sherin, B. L. (2012). Framing in cognitive clinical interviews about intuitive science knowledge: Dynamic student understandings of the discourse interaction. *Science Education, 96*(4), 573-599.

[7] Heng, M. A., & Sudarshan, A. (2013). "Bigger number means you plus!"—Teachers learning to use clinical interviews to understand students' mathematical thinking. *Educational Studies in Mathematics, 83*(3), 471-485.

[8] Hewson, P. W. (1982). A Case Study of Conceptual Change in Special Relativity: The Influence of Prior Knowledge in Learning‡. *European Journal of Science Education, 4*(1), 61-78.

[9] Andrews, B., Brown, S., Montfort, D., & Dixon, M. (2010). Student Understanding of Sight Distance in Geometric Design. *Transportation Research Record: Journal of the Transportation Research Board, 2199*(-1), 1-8. doi: 10.3141/2199-01

[10] Brown, S., & Lewis, D. (2010). *Student Understanding of Normal and Shear Stress and Deformations in Axially Loaded Members.* Paper presented at the American Society of Engineering Educaiton, Louisville, KY.

[11] Streveler, R. A., Montfort, D., Herman, G. L., Brown, S. A., & Matusovich, H. M. (2014). *Conceptual Change Across Engineering Disciplines.* Paper presented at the American Society of Engineering Education, Indianapolis, IN.
[12] Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology, 53*, 109-132.
[13] Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of educational research, 65*(3), 245-281.
[14] Schunk, D. H., & Zimmerman, B. J. (2012). *Motivation and self-regulated learning: Theory, research, and applications*: Routledge.
[15] Heaton, J. (2004). *Reworking qualitative data*. Thousand Oaks, CA: Sage.
[16] Stake, R. E. (2006). *Multiple case study analysis*. New York, NY: The Guilford Press.
[17] Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). Thousand Oaks, CA: Sage Publications.
[18] Montfort, D., Herman, G. L., Brown, S. A., Matusovich, H. M., Streveler, R. A., & Odelesoup, S. (Revision Under Review). Patterns of Student Conceptual Understanding Across Engineering Content Areas.
[19] Brown, S. A., Montfort, D., & Findley, K. (2007a). *Development, Implementation, and Assessment of a Bending Stress Tutorial.* Paper presented at the ASEE/IEEE Frontiers in Education Conference, Milwaukee, WI.
[20] Brown, S. A., Montfort, D., & Findley, K. (2007b). *Student understanding of states of stress in mechanics of materials.* Paper presented at the ASEE Annual Conference & Exposition, Honolulu, HI.
[21] Brown, S. A., Montfort, D., & Hildreth, K. (2008). An investigation of student understanding of shear and bending moment diagrams. In W. Aung, J. Mecsi, J. Moscinski, I. Rouse, & P. Willmot (Eds.), *Innovations 2008: World Innovations in Engineering Education and Research* (pp. 81-101): Begell House Publishing.
[22] Montfort, D., & Brown, S. A. (2011). *Building fundamental engineering knowledge: Identification and classification of engineering students' preconceptions in mechanics of materials.* Paper presented at the Annual Conference of the American Educational Research Association, New Orleans, LA.
[23] Patton, M. Q. (2002). *Qualitative Research & Evaluation Methods* (3rd ed.). Thousand Oaks: SAGE Publications.
[24] Boekaerts, M. (1992). The adaptable learning process: Initiating and maintaining behavioural change. *Applied Psychology, 41*(4), 377-397.
[25] McCord, R., & Matusovich, H. M. (Under Review). Study Context Matters: Time Crunches Lead to Coping Modes of Learning.
[26] Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: W.H. Freeman.
[27] Matusovich, H. M., Stephenson, J., Montfort, D., & Brown, S. A. (2013). *Voices in Their Heads: Motivational Utterances in Engineering Problem Solving.* Paper presented at the American Educational Research Association 2013 Annual Meeting.
[28] Jones, B. D. (2009). Motivating students to engage in learning: The MUSIC Model of Academic Motivation. *International Journal of Teaching and Learning in Higher Education, 21*(2), 272-285.