

Applying Stages of Change in an Academic Context to Help Students Adopt Healthy Learning Dispositions and Behaviors

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Abstract— In this work in progress paper for the research category, we describe preliminary results from our design-based research project. Students leave engineering majors for many reasons. However, studies on goal orientation theory have shown that mastery goal orientation has positive correlations with outcomes such as persistence, self-efficacy, and self-regulated learning. We developed and taught an eight-week, one-credit course called *Engineering the Mind* as an intervention to encourage students to adopt positive learning dispositions and behaviors. We used the Stages of Change model as our theoretical framework to understand how engineering students adopt these learning dispositions and behaviors. We used multiple methods to assess student outcomes, collecting pre-post survey data as well as students' self-reflection assignments. In our preliminary results, we describe students in different Stages of Change based on their weekly course assignment on planning.

Keywords—design-based research, Stages of Change, mindset, goal orientation, self-regulation

I. INTRODUCTION

Student attrition is a major concern of engineering programs. Only 49.7% of students who began in engineering in 2007 attained an engineering degree within 5 years [1]. Students leave engineering for a variety of reasons, including diminished interest [2], poor teaching and advising [3], and lack of confidence in mathematics and science skills [4]. In contrast, when students adopt a growth mindset and a mastery goal orientation, that is, a focus on learning, understanding, and mastering information, they experience outcomes such as persistence, self-efficacy, and self-regulated learning [5]. In our study, we explored whether we could help students persist in engineering by encouraging such positive learning dispositions and behaviors. By positive learning dispositions, we mean the growth mindset and mastery goal orientation. By positive learning behaviors, we mean self-regulation skills.

We developed and taught an eight-week, one-credit course called *Engineering the Mind*. We used the design-based research methodology and the Stages of Change model (also known as the Transtheoretical Model of Health Behavior

Change) to design the course and assess the outcomes. The content of the course was designed to align research on neuroscience and various fields of psychology (e.g., cognitive, behavioral, and educational) with growth mindset, mastery goal orientation, and self-regulation skills. The goal of the course was to teach students how the brain works to encourage students to adopt positive learning dispositions and behaviors.

II. BACKGROUND

We used design-based research (DBR) as our method to develop and evaluate theory-based interventions in complex, real-life contexts such as the classroom [6]. By theory-based interventions, we mean interventions developed in laboratory conditions. DBR studies produce both theory and practical interventions. We used DBR in our study by applying the Stages of Change model to design the *Engineering the Mind* course. Details of the course design can be found in our previous paper [7].

The Stages of Change model was developed using key constructs from other theories to describe behavior change [8]. This model has been used to promote changes in health behavior such as smoking cessation, weight control, and exercise acquisition. There are five stages of behavior change: precontemplation, contemplation, preparation, action, and maintenance. Precontemplation is the stage in which people do not intend to take action to change. Contemplation is the stage in which people intend to take action to change around the next six months. Preparation is the stage in which people have made plans to take action such as obtaining a gym membership or consulting a counselor. Action is the stage in which specific lifestyle changes have been made within the past six months. Maintenance is the stage in which people work proactively to prevent any relapse. Furthermore, there are ten processes of change that help people move from one stage to another (see Table 1). The five experiential processes are primarily used for transitions between the early stages, whereas the five behavioral processes are primarily used for transitions between the later stages.

TABLE I. TEN IDENTIFIED PROCESSES OF CHANGE IN THE STAGES OF CHANGE MODEL [9]

Experiential Processes	Examples
1. Consciousness raising 2. Social liberation 3. Dramatic relief 4. Environmental reevaluation 5. Self-reevaluation	1. Increasing awareness 2. Realizing the public system supports healthy behavior 3. Understanding emotions (fear, anxiety, hope, inspiration) 4. Noticing effect on others (negative or positive) 5. Creating a new self-image
Behavioral Processes	Examples
1. Self-liberation 2. Counter conditioning 3. Reinforcement management 4. Helping relationships 5. Stimulus control	1. Believing in one's ability to change and making commitments to change 2. Find appropriate substitutes for negative behavior with healthy behavior 3. Increase rewards for positive behavior, reduce for negative behavior 4. Finding social support 5. Managing your environment

To encourage positive learning dispositions, we promoted the growth mindset from Dweck's implicit theory of intelligence [10] and mastery goal orientation from goal orientation theory [11]. Students with the growth mindset believe that intelligence can be improved with effort, whereas students with the fixed mindset believe that intelligence cannot be changed [10]. Students with the growth mindset tend to adopt a mastery goal orientation in that they strive to develop competence [5]. In comparison, students with the fixed mindset tend to adopt a performance goal orientation in which they strive to earn a grade or to perform better than their peers. There are two types of performance goal orientations: performance avoidance and performance approach [11]. In performance avoidance, students avoid situations where they have to demonstrate their ability, whereas in performance approach, students want to openly demonstrate their ability to others. To encourage positive learning behaviors, we taught self-regulation skills [12]. Self-regulation is a metacognitive behavior where students plan, monitor, and adjust their behavior to achieve their goals [12].

We investigated two research questions. First, can we influence students' mindsets, goal orientations, and self-regulation through the *Engineering the Mind* course? Second, how well does the Stages of Change model describe changes in learning dispositions and behaviors in the context of the *Engineering the Mind* course? In this paper, we present preliminary qualitative results to answer the second research question. Our research project was approved by the local Institutional Review Board (IRB#17595).

III. METHODS

A. Participants

We offered two sections of the *Engineering the Mind* course during the Fall 2017 semester at a large, public research university in the Midwest. There were nine students in one section and eight students in the other, for a total of 17 students. All students submitted consent forms, which were collected by a graduate student who was unaffiliated with the course. The forms were sequestered until after final grades were submitted. At that time, we found that 15 students had consented to have their data (i.e., their course assignments) used for research.

B. Data Analysis

We collected both quantitative and qualitative data from the students so that we could use multiple methods to understand various nuances of the course. For quantitative data, we administered a pre- and post-survey during the first and last week of the course, respectively. Details of the quantitative data analysis can be found in our previous paper [13].

For qualitative data, we collected all course assignments: Reaction Papers, Reflection Papers, Strategy Documents, and Final Papers. Students wrote Reaction Papers to document their thoughts on TEDTalks and readings that were assigned as homework. Students wrote Reflection Papers to document their thoughts after in-class discussions and after reflecting on the week's topics. Students maintained Strategy Documents to plan and evaluate weekly academic goals (e.g., splitting up weekly problem sets into daily quotas). In lieu of a final exam, students wrote Final Papers in the form of a letter to their high school self (or to a friend in high school). These letters included what students wished they had known before coming to college and what students wanted to share from the *Engineering the Mind* course.

For qualitative methods, we will use the Stages of Change model as our theoretical framework to analyze students' course assignments. For example, we will use semi-open coding using the five stages of change and ten processes of change for a priori codes. We will also use open coding to capture unexpected data. Using these codes, we will perform thematic analysis to identify what aspects of the course were salient and whether the design of the course using the Stages of Change model supported the change process. For our preliminary analysis, we analyzed students' Reflection Papers, specifically, the portions regarding their Strategy Documents.

IV. PRELIMINARY RESULTS

Despite planning academic goals for each week in their Strategy Document, some students' Reflection Papers revealed that they often failed to follow through on their plans. However, after reflecting on and evaluating their Strategy Document each week, students described an increase in awareness of their shortcomings. We've ordered the excerpts to portray how students are in different stages of change. We randomly labeled students with letter ranging from A through O.

The insights I have gained by doing the strategy document is to show me just how far I am willing to go to make excuses for not starting to do my work. It also has showed me that even though I have a decent amount of time in the week much of it goes to anything but actual productive work. (Student H)

Student H was most likely in the precontemplation stage since he didn't realize that he needed to address his problem with procrastination. The Strategy Document helped him understand that he had a problem with procrastination.

I think that if I am not doing well in a class, it most certainly is worth changing my strategy. Unlike my previous years in undergrad, this class actually forced me to write down my strategy for the first time. I think actually looking at my strategy did help me making it better. I would always tell myself to not procrastinate on my homework but it took several times of actually typing out not to each week to finally not procrastinate my ENTIRE assignment the night before or day of. Like most things in life, the strategy document is easier said than done. (Student J)

Student J was most likely in the contemplation stage because he understood that it's worth changing his habits if he wasn't doing well in a class. The Strategy Document helped him with the preparation stage by planning his strategy each week, but it took him several failed attempts to finally follow through on his plans.

I've learned a lot about how I actually work. I always pictured myself as this very busy, very efficient college student. Analyzing how much free time I had and where I was spending it was an eye opener. I've also learned that I work well when I distribute my work load evenly over several days and I am most efficient when I isolate myself from all distractions, such as when I am studying in the [library] study carrels. I've also learned that sleeping well really affects my ability and willingness to work. (Student M)

Student M was most likely in the action stage because she distributed her work load, isolated herself from distraction at the library, and monitored her sleeping habits. The Strategy Document helped her track all the benefits of her actions. If she were to continue monitoring her behaviors, she would be considered to be in the maintenance stage.

I have practiced my strategy for 4 weeks (including Thanksgiving break). Using the strategy document, I have [learned] that people, without sufficient self-control like me, can apply both internal and external pressure to keep learning and [make academic progress]. The part that has helped me the most is the consequence and fail log[, where] I wrote... what would happen [to me] if I fail to complete my checkpoints. [By imagining and articulating the consequences of my failures before they actually happen], I can keep myself working and do not procrastinate with my homework and assignments. (Student F)

Student F was most likely at the maintenance stage when he was writing this assignment. It is clear that he took actions

for the four weeks and continued to maintain his "consequence and fail log" to reduce procrastination.

V. LIMITATIONS

The content of students' Reflection Papers depended on the instructor's prompts for the reflections and on the students' willingness to respond candidly. The assignments required 200 to 300 words, and most students stopped after achieving the minimum word count. Only a few students wrote much more than the required minimum. Furthermore, what students wrote wasn't always clear. Some students wrote very shallow descriptions of their thoughts, some of which weren't even complete thoughts. In the future, we will consider student interviews to probe their thinking more deeply.

VI. SIGNIFICANCE AND FUTURE WORK

The Stages of Change model has primarily been used in clinical contexts to investigate health behaviors such as smoking cessation and weight control. Our study applied the Stages of Change model to an academic context to understand how engineering students adopt positive learning dispositions and behaviors. Based on our preliminary qualitative results, we found that students are at different stages of change. This finding suggests that some students will take longer to adopt positive learning behaviors than others. However, we can see that the Strategy Document helped them with consciousness raising to at least move from them precontemplation stage (e.g., not thinking about changing) to the contemplation stage (e.g., considering change), and to help them to stay in the maintenance stage.

Based on our preliminary quantitative, pre-post survey results, the *Engineering the Mind* course helped influence students to adopt the growth mindset [13]. However, we saw no statistically significant pre-post differences in goal orientation or self-regulation scores. Adopting the growth mindset alone does not imply that students would be more likely to persist in engineering, but it may be the first step in helping students persist. We recognize that change takes time, and that follow-up courses may be necessary to help students adopt more positive learning behaviors.

In the future, we plan to develop follow-up courses to help students continue to apply what they have learned from the *Engineering the Mind* course. We also plan to track students over time to determine whether these courses help retain engineering students. If these courses are effective in retaining engineering students, then other institutions could adopt them to help retain their students.

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