

# Understanding Students' Perception of Academic and Professional Relevance in STEM Courses

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**Abstract**—In this Work-in-Progress paper we examine students' situational motivation in introductory STEM courses through analysis of survey responses about students' experiences in a required course at each of two large public institutions. The students in each course convey different perceptions of course relevance: learning-performance relevance and temporal relevance. Learning-performance relevance, exclusive to Course A, refers to students' perceptions of course content and activities as relevant to their performance, which in turn serve as necessary prerequisites for achieving future academic and professional goals. Temporal relevance, described primarily by students in Course B, pertains to students' non-performance-based perceptions of course content as applicable to their long-term academic and professional careers, as well as their personal intellectual growth. We posit that understanding the ways in which students perceive the relevance of course assessments, content, and activities to their near- and long-term future aspirations may allow for improved instructor support of intrinsic motivational attitudes in STEM classrooms.

**Keywords**—*motivation; relevance; performance; introductory STEM courses; examination-driven perceptions*

## I. INTRODUCTION

Educational research presents a compelling case that motivation - the psychological drive to take action - is tightly connected to outcomes such as development of positive self-efficacy, critical thinking, creativity, self-regulation, and pro-social behavior [1-4]. These outcomes are identified as key to the success of future STEM graduates [5-7]. The path to maximizing these positive outcomes, however, is far from straightforward: motivation is a complex phenomenon that depends on learner needs, goals, expectations, values, and identity, as well as a range of social and contextual factors [8].

Research shows that motivational orientations and their associated behaviors in the classroom are influenced by students' perceptions of relevance [9]. Many motivational theories define, implicitly or explicitly, a construct of relevance as the identification of a meaningful connection to a situation or activity. Self-determination theory (SDT), for example, includes the concept of relevance in its discussion of internalization, the process by which individuals transform external demands or expectations into personally endorsed values by finding utility, importance, interest, or enjoyment in an activity [10]. Achievement goal theory incorporates the idea of relevance in describing how individuals appraise classroom environments and adopt different goals based, in part, on how

they perceive learning tasks as connected or valuable to themselves [11]. Expectancy-value theory directly addresses aspects of relevance in its task value construct, which includes the components of attainment value (importance of doing well), intrinsic value (enjoyment, interest), utility value (relationship to individuals' future plans), and cost (emotional, effort, or time demands) of a task [12]. Given the importance of relevance to motivation, gaining insights into the ways STEM students find relevance in learning tasks, and how these connect to personal interests or aspirations, and classroom contextual factors, may help instructors select pedagogies and design experiences that promote positive engagement.

This paper explores the ways in which STEM students at two different schools describe relevance in their week-to-week course experience. Specifically, we ask: (1) how do students find future academic and professional relevance in their coursework, and (2) how does an examination-driven learning environment affect students' perceptions of course relevance?

## II. METHODS

This qualitative work is a part of a larger mixed-methods study about students' situational motivation in introductory STEM courses. This paper focuses on one required course at each of two public institutions: a traditional lecture-based introductory chemistry course with multiple examinations throughout the semester, Course A, and a lecture-based materials science course with a project orientation and one final examination at the end of the semester, Course B. The study population consists of three men and six women from a variety of majors in Course A, and three women and four men, all engineering majors, in Course B. The similarities and diversity of pedagogical and curricular practices at the two schools are shown in Table 1. The study instrument is a seven-item open-ended survey about activities, emotions, motivational responses, perceived course relevance, and performance administered to students approximately every other week. The instrument was interpretively validated through participant feedback [13].

In this paper, we use grounded theory approach [14,15] to analyze how students respond to one of the survey questions: "Please reflect on the extent to which your experience over the past week in the course was personally relevant for you now and in the future. Give specific examples." We use students' responses to other questions as additional data sources informing our analysis.

Starting with in-vivo and open coding strategies, we performed axial and selective coding using constant comparative method [16]. The initial coding pass focused on the participants' language. This allowed us to develop definitions for significant words and phrases that were common in their language. Using the codebook, multiple researchers separately coded a subset of the data and then discussed any discrepancies to improve code definitions. This process was repeated to construct a final codebook and improve inter-coder reliability. The data were coded for important concepts and themes followed by organization of codes into thematic matrices [17]. Analytical memos then were developed to assist in identifying emergent themes. All qualitative data were read and coded using Atlas.ti software.

TABLE I COURSE CONTEXTS

	Course A	Course B
Course Subject	Chemistry: Lecture/Lab	Materials Science and Engineering
Course Activities (reported by instructor)	Lectures, recitation, clicker, worksheets, quizzes, homework, online homework, video demonstrations, office hours, tests, final exam	Lectures, discussion, video demonstrations, clickers, self-reflection, team project, poster presentation, online quizzes, in-class group activities, final exam

### III. RESULTS AND DISCUSSION

Although the survey question asks about course experience over the past week, participants typically interpret "course experience" to mean course content, which they refer to as "material," or course activities. Our analysis demonstrates that students make many different types of personal connections to weekly course content and activities. For this paper, we focus on two that constitute a large portion of responses: relevance of course content and activities to students' (1) performance now and in the future, and (2) future academic and professional careers and personal intellectual growth.

#### A. Learning-Performance vs. Temporal Performance

Our analysis indicates that students at the two institutions perceive course relevance differently. Course A students perceive course content and activities as relevant primarily to their performance, a prerequisite for future academic and professional career development. Course B students predominantly find application of content rather than performance as relevant to their interest or future professional development, while few Course A students describe course relevance in this way. As shown in Figure 1, we describe these two student perceptions of course relevance as: (1) learning-performance relevance, and (2) temporal relevance. The emergent definitions of these course relevance perceptions are:

##### 1) Learning-Performance Course Relevance Perception:

Students describe course content and activities as relevant to their near-term course performance goals and outcomes. Students identify performance on both individual assessments and in the course as a requirement for their future courses, major, or career goals.

2) Temporal Course Relevance Perception: Students describe possible long-term future applications of course

content and activities, or identify that they do not find these connections. Student-identified future applications fall into three categories, all non-performance-based: academic applications (future classes/major), career applications, and opportunities for personal intellectual growth.

While students discuss future courses, major, and career in both learning-performance relevance and temporal relevance narratives, they do so differently. In learning-performance relevance discourses, students emphasize short term goals: students consider grades and performance as "stepping stones" to achieving future goals, and they do not identify a deep connection between specific course content and the work they will be doing in the future. Exam and course performance either deter or promote students' perception of whether they can progress toward future work; however, students describe only short-term performance outcomes rather than possible future scenarios.

In temporal relevance discourses, students focus on their long-term goals rather than short-term outcomes, directly connecting course material to their imagined future selves. When students find personal relevance in their course content and activities in the form of applications to their future, they perceive having opportunities for personal growth, academically, professionally, and intellectually.

We discuss each of these types of relevance perceptions in greater detail in the following sections.

#### B. Learning-Performance Course Relevance Perception

Course A students take several exams throughout the semester and a final exam; performance on these assessments makes up a large percentage of their final grade. These students identify the importance of exams, grades, and final course performance as the primary way in which the course is relevant to them, because it impacts their course success or satisfies grade and credit requirements (Fig. 1). A typical response from a Course A student about the importance of good grades is exemplified in the following quote,

*The past week was very relevant to me because I want to get a good grade in this class both so it will transfer as credit ... and so that I can get into medical school.* (Patrick, Course A)

Patrick notes that the course over the past week is only as relevant as attaining "a good grade," a necessary prerequisite for attaining his goal of "get[ting] into medical school." Of note is that Patrick's discourse indicates a relatively short-term goal: for Patrick it is about being *accepted* into medical school rather than about a career path that medical school may allow him to take.

In responding to the same question about course relevance during previous week, another Course A student notes the impact of performing poorly,

*The fact that I took an exam means the course was very relevant to me (this past week especially) because it was the first exam of the semester. This was a preview of my performance for the semester, which doesn't mean the best for me.* (Kevin, Course A)

Kevin perceives exam performance early in the semester to be a significant indicator of future performance in the course. His attention is not on mastering useful knowledge or skills, but rather on successfully passing over the exam hurdle. Throughout the semester, Kevin continues to express a similar sentiment in his response to the question about course relevance. In his final week, Kevin further emphasizes the consequences of poor performance on his ability to attain future goals,

*This course became relevant to me once I realized how poorly I was doing. I began to reevaluate my entire future with respects to my choice of major and ultimately, my long term career.* (Kevin, Course A)

One interpretation of Kevin's response is that he discursively positions the course as not relevant to him. In fact, he may have never realized course relevance if he performed well. In this case, it is poor performance that allows Kevin to gain a sense of course relevance; however, he then focuses on this aspect of the course for the duration of the semester and feels defeated at the end of the academic term. Kevin believes he needs to reevaluate entire future plans as a result of his performance in this one introductory course, indicating that he may be viewing his ability to achieve his future career through the lens of his course performance, i.e., short-term performance-based relevance perception.

Patrick and Kevin's responses are representative of Course A students. Performance seems to be the motivating factor for the Course A students in their weekly course activities (Fig. 1). This leads to students completing the course feeling either accomplished or defeated mainly based on their performance relative to their expectations or to external academic demands (e.g., qualifications for entrance to medical school).

### C. Temporal Course Relevance Perception

We find examples of temporal course relevance perception in both courses, but primarily in Course B. As shown in Fig. 1, students' comments consistent with this type of relevance perception describe applications of the course to their imagined future, whether it is for their future courses and major, their future career goals, or their intellectual growth. The emphasis in students' reflections here is on long-term futures rather than short-term learning performance outcomes. For example, Justin, a Course A student, identifies that the course content will be useful to his future physics courses,

*The material on entropy, and thermodynamics as a whole, will be heavily used in my future classes on thermal physics and statistical mechanics.* (Justin, Course A)

In this case, Justin predicts he will apply the content knowledge gained in this course to his future classes. Another student, Mary Jane, describes how "real-life" applications are important to her career goals,

*Our teacher did a good job this week of relating the material to real life applications. When making design decisions having to do with materials as an engineer, this course ... will be really helpful.* (Mary Jane, Course B)

Mary Jane explicitly connects course material to her future career, shown as the central branch for temporal relevance in Fig. 1. She envisions herself as an engineer who makes decisions that rely on her understanding of course material.

The expression "as a/an [career identity]" (e.g., "as an engineer,") is characteristic of students who use temporal course relevance perception discourses in relation to their future career. We find this expression predominantly in the descriptions of Course B students. In comparison, only one Course A student, Carolyn, uses this language when talking about her future plans as a vet,

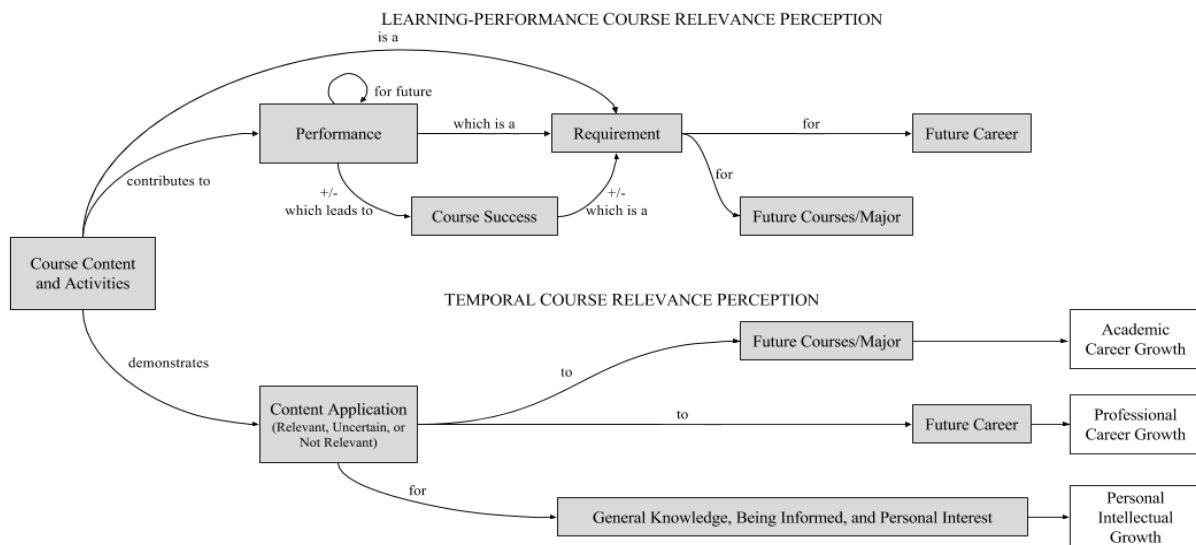


Figure 1. This diagram displays learning-performance and temporal course relevance perceptions. The upper path of this diagram shows student response patterns for learning-performance course relevance perception, in which course content and/or activities contribute to performance, a perceived requirement for future courses, major, and career. The lower path displays temporal course relevance perception, in which students perceive course content and activities to be applicable in three areas: future courses/major, future career, and general knowledge. In temporal course relevance perception, students identify opportunities for academic, professional, and intellectual growth.

*This experience was slightly relevant to my future as a vet because I will need to understand acids and bases to ensure the safety of my patients. I also need to successfully pass this class in order to move on to higher level classes ... for my major and attending vet school. (Carolyn, Course A)*

This quote represents an instance of both temporal relevance and learning-performance relevance. Carolyn first identifies the course as having temporal relevance to her future career, and specifically mentions how understanding this particular content will help her serve her clients. Carolyn also draws attention to near-term learning performance relevance in identifying the need to pass the class to move on in her academic program.

Lastly, students mention application of content in developing of their own personal interest and intellectual growth, depicted in the lower branch of temporal relevance perception in Fig. 1. For example, Rachel describes relevance of the content to her personal growth as,

*The material learned will help me in the future because we learned about something that is new and in the news all the time. This ... will keep me [be] more informed and with the progressing times I will be up to date. (Rachel, Course A)*

Rachel identifies understanding material as a prerequisite for staying informed and being a life-long learner. This type of relevance is only highlighted in temporal relevance narratives, that is, when students describe possible future application of the course content.

#### D. Examination-Driven Student Perceptions

Both Course A and Course B include lectures and a final exam. In both settings, students mention the exams in their response to course relevance survey question, but they do so differently. In Course A, students emphasize studying and performance, a characteristic of learning-performance relevance perception. In Course B, which has a single (final) exam, students do not describe learning-performance relevance, but they nonetheless reflect on the process involved in preparing for and taking an exam. Rather than focusing on performance, Course B students question the learning involved in the act of test taking. Colin reflects on this after the final,

*I think I didn't learn much over the past week since I was just preparing for the final. (Colin, Course B)*

Instead of focusing on how much he worked or how well he did, Colin notes he was “just preparing for the final,” potentially indicating that studying for exams is not how he learns best. In comparison, Malcolm shares a different perspective on the role of test taking in his learning processes,

*Studying for the final is where I learned the most material... (Malcolm, Course B)*

Although their attitudes toward the final are different, both Colin and Malcolm consider how this type of assessment may affect their learning rather than their performance outcomes.

Prompted by the need to study for a test, another Course B student, compares both performance and learning orientations,

*... earning the grades more than learning ... is bad. I believe that we should [be] concentrating on the learning*

*more. The problem is the system that schools put us through ... Tests challenge... our memorization rather than what we learned. (Darius, Course B)*

Darius asserts that tests compel students to memorize rather than learn and he implies that grades and learning are incompatible. In other words, Darius seems to reject the idea that near-sited performance-driven environments can benefit his future development as a learner, a characteristic of students with a temporal course relevance perception. It is apparent that in considering course relevance, students weigh the possible tensions between, and the task value of, performance- and mastery-related actions; these student-initiated evaluations of the learning situation are examined in more detail in the motivation literature [e.g., 11,12,18,19].

#### IV. CONCLUSIONS AND FUTURE WORK

Our preliminary emergent framework describes ways in which students identify situational relevance of their coursework: learning-performance relevance and temporal relevance. Regardless of the types of relevance students find in their coursework, they are often driven by their future aspirations. Students who are primarily focused on exam outcomes identify the current course as relevant to their future only as a performance requirement (i.e., “stepping stones”) in their future careers. Academic, professional and intellectual personal growth are more frequently cited when students find temporal relevance, or meaningful connections of the course learning to their future career or personal growth.

Although not an explicit analytical theme in the present study, it is notable that performance relevance discourses use initial stages of reflective practice, i.e., description of an event and associated affective responses [e.g., 20]. In comparison, temporal relevance discourses go beyond these initial stages to include reflection-in-action and prospective thinking about future actions while leveraging critical, reflexive, and post-modern lenses [e.g., 21-23]. Darius’ criticism of social structures in response to a question about course relevance indicates a much deeper engagement with learning, understanding of oneself, one’s positioning with respect to knowledge and learning, etc. We posit that frequent summative assessments may allow room for students to engage in more reflective practices, including development of temporal relevance perception, as seen in Course B, which is an explicit goal of engineering education of today [5, 24-25].

Understanding students’ perceptions of course relevance may help instructors identify how students draw meaningful connections between coursework and their imagined future selves. Our future work will include examining factors that contribute to students’ self-identified relevance, such as performance outcomes and emotional impacts of coursework, as well as identifying pedagogical activities that may result in development of a specific type of relevance perception.

#### ACKNOWLEDGMENT

This work was supported in part by grants from the National Science Foundation (DUE #1445950, DUE #1322684, and DUE #1156832).

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