

Physics Students' Mindsets and Their Impact on Learning and Perceived
Satisfaction

by
Tiffany Le

A THESIS

submitted to

Oregon State University

Honors College

in partial fulfillment of
the requirements for the
degree of

Honors Baccalaureate of Science in Biochemistry and Molecular Biology
(Honors Associate)

Presented June 1, 2022
Commencement June 2022

AN ABSTRACT OF THE THESIS OF

Tiffany Le for the degree of Honors Baccalaureate of Science in Biochemistry and Molecular Biology as presented on June 1, 2022. Title: Physics Students' mindsets and their impact on learning and perceived satisfaction.

Abstract approved: _____

KC Walsh

Characterizing a mindset landscape within the physics classroom is crucial to portray the variation and context of mindset in the classroom. This paper will be looking at students enrolled in Oregon State University's PH20x series, which is a series of three algebra-based introductory physics courses. This project is an exploratory model which intends to obtain data on students' fixed or growth mindsets through mixed methods. The approach will utilize a three-pronged method to get an in-depth, yet large scope of understanding of students' mindsets. This will be achieved by conducting interviews on several students, supplemented with a follow-up email to explore whether having a fixed or growth mindset leads to greater outcomes or perceived satisfaction. Interviews were analyzed utilizing Angie Little's Codebook [1]. For a broader understanding of the student population, a Likert scale will be distributed to all students within the class.

Themes of context and conditional dependency emerged during the analysis of the transcripts. Contextual dependency seems to affect both mindset and response, and applicability to the future was seen as the greatest influence in transcripts showing contextual dependency. For students showing a conditionally dependent mindset, performance is a large component in dictating a student's response to challenge.

Keywords: physics, mindset theory, motivation, fixed, growth, satisfaction, learning, implicit, entity, incremental

Corresponding e-mail address: letif@oregonstate.edu

©Copyright by Tiffany Le
June 1, 2022

Physics Students' Mindsets and Their Impact on Learning and Perceived
Satisfaction

by
Tiffany Le

A THESIS

submitted to

Oregon State University

Honors College

in partial fulfillment of
the requirements for the
degree of

Honors Baccalaureate of Science in Biochemistry and Molecular Biology
(Honors Associate)

Presented June 1, 2022
Commencement June 2022

Honors Baccalaureate of Science in Biochemistry and Molecular Biology project of Tiffany Le presented on June 1, 2022.

APPROVED:

KC Walsh, Mentor, representing Physics Department

Lori Kayes, Committee Member, representing Biology Department

Scott Peterson, Committee Member, representing Mathematics Department

Toni Doolen, Dean, Oregon State University Honors College

I understand that my project will become part of the permanent collection of Oregon State University, Honors College. My signature below authorizes release of my project to any reader upon request.

Tiffany Le, Author

Table of Contents

Introduction	8
Literature Review	8
A. Mindset Theory - Implicit Theory of Intelligence	8
B. Mindset Research in the Educational Sphere	9
C. Correlation with Perceived Satisfaction	9
Research Goals.....	9
A. Population	9
B. Research Questions	10
Methodology	10
A. Overview	10
B. Development of Interview Process	11
C. Likert Scale	11
D. Follow-up Email	12
Results and Discussion	12
Analysis of Qualitative Data.....	12
A. Belief Statements	13
B. Learning Orientation	13
C. Groupings of Mindset	13
1. Fixed Mindset, Fixed Response	14
2. Fixed Mindset, Growth Response	14
3. Growth Mindset, Growth Response	15
4. Growth Mindset, Fixed Response	15
D. Theme of Context-Dependency	16
E. Theme of Conditional-Dependency	17
Analysis of Likert Scale Data	17
A. Population Likert Scale Data	17
B. Comparative Sample of Interviewed Students to Population	19
C. Student Mindset Indication in Likert Scale Data as compared to Interviews	20
D. Likert Scale Summary.....	21
Take-aways	21
Conclusion & Future Research	22
References	23
Appendices	
A. Narratives	25
B. Interview Questions	32
C. Coding Table	35

I. Introduction

Mindset Theory proposes that people hold differing beliefs regarding the malleability of human attributes [2]. It has since become a long-standing proposition that there are two primary mindsets that a person can navigate life with: a fixed or growth mindset [3]. The theory maintains that the adoption of one mindset over the other will result in differential outcomes, due to the self-conceptions people use to structure the self and guide their behavior.

A large subsection of research exists which explores how academic mindset plays a large variable in success outcomes. This has been explored at a variety of schooling levels, especially with a focus towards quantitative research to explain the theory [1]. However, oversimplification of a student's mindset as either fixed or growth often occurs, without exploring the motivations or context underlying a student's mindset [4]. This can be especially commonplace in quantitative research. Despite this, qualitative mindset research is limited, and especially sparse within college introductory courses [1]. The goal of this paper is to explore student mindset in an introductory physics course, probing the notions and context behind a student's mindset regarding their physics intelligence, using Likert scale data and interviews as analyzed by Angie Little's Codebook [1].

II. Literature Review

A) Mindset Theory - Implicit Theory of Intelligence

Non-cognitive factors, especially of note, academic mindset and behavior, can critically influence academic performance [5]. These factors are encapsulated within Carol Dweck's implicit theories, which explain how mindset affects a person's motivation and behavior. Dweck has categorized these mindsets into entity and incremental theories of intelligence [3]. Those that hold an entity theory of intelligence will tend to attribute their failure or success to a fixed trait, often overvaluing an inherent trait as the source of their performance. In contrast, a person who holds an incremental theory of intelligence believes that their intelligence is malleable, notions which follow the idea that intelligence may not hold equivalent importance for success as compared to persistence or effort in the face of challenge. A particular mindset will be prominently evident during challenging events or in times of difficulty. Specifically, within an academic circumstance, mindset can be predicted by observing by a student's ability to cope with challenges and setbacks in the classroom. "The students who love challenges, who are willing to take risks, and who thrive when they hit obstacles are the ones who achieve up to, or beyond, their apparent potential. These students may not start out being highly skilled, but they become skilled over time. The students who are afraid of challenges, who avoid risks, and who wilt when they fail (or run from failure situations) are the ones who lose ground over time" [6].

In the face of challenge, those with an entity theory will mirror responses of negative affect or which resemble a helplessness response, characterized by a lack of persistence. Opposing this, those that hold an incremental theory will understand that performance may be linked to behavioral choices, such as amount of time placed in learning a topic or strategical effectiveness. Years of research within this field have

elucidated both incremental and entity theories, which are now colloquially known as fixed and growth mindsets.

B) Mindset Research in the Educational Sphere

Fixed and growth mindset research within the educational sphere has been prevalent, and educators value the importance of incorporating these theories into the pedagogy of instruction. The influence of a growth mindset seems instrumental and profound: The behavioral choices that are made can influence success in any sphere or field. This is confirmed by prior research which indicates a growth mindset as a strong predictor for academic success [7]. Even across the socioeconomic strata, holding a growth mindset “appreciably buffered against the deleterious effects of poverty on achievement” [8]. Thus, it can be thought of as a tool which helps to overcome challenges and achieve success. Fostering a growth mindset has been emphasized, and has even led to classroom interventions, where students are exposed to material which aim to actively persuade students about the malleable nature of their intelligence. Growth mindset scores for students were then determined, usually through quantitative approaches, and intervention efforts have yielded good results in increasing growth mindset scores [9].

C) Correlation with Perceived Satisfaction

A growth mindset correlates with positive effects on student motivation, often leading to higher levels of perceived satisfaction and increases in categories such as self-efficacy [10]. However, prior research has also shown that alignment with a growth mindset does not directly correlate with an increase in grades, as would be expected with adopting characteristics of resiliency. Although mindset and self-efficacy did change, academic performance was independent of this [11]. This, in conjunction with other prior research that show difficulty attaining results similar to Dweck’s [12], suggests that implicit theories and mindset data are not fully understood.

Further complicating things, mindset beliefs may seem a stable dimension or disposition, although other authors suggest that mindset may depend on both disposition and situational factors [13]. These situational factors have not fully been explored due to an inherent complex, varying nature, explaining some of the difficulties in documenting results similar to Dweck’s. Moreover, there are other different complications that may arise with mindset research, such as differing definitions, contextual factors, and interplay between mindset and different psychosocial factors (such as intrinsic emotions). This has been an unexplored area of mindset research thus far and is the prerequisite knowledge for implementing interventionist efforts within the classroom.

III. Research Goals

A) Population

Research and analysis will occur on the sample of OSU physics students that are enrolled within the PH20x algebra-based Introductory Physics series, a challenging mid-level STEM series at a single large public university with very high research activity. We recruited participants from physics as it is a required course for many professional

schools and STEM majors. Further, because we were interested in exploring how students cope with struggle and the relationship between their academic performance and mindsets, we wanted to target a particularly challenging course, and physics has a national and local reputation for being a challenging STEM course. It is important to note that this algebra-based physics course is not included within students' major-specific courses, which could play a large factor in a student's motivation and interest in the course.

In general, the physics community as comprised of physicists, is not as diverse as we would like and can be characterized by an underrepresentation of minorities and women [14]. There is a general notion that pursuing physics is typically for a select club, those historically seen as being intellectual, precluding some minorities due to stereotypical beliefs about intelligence [15]. Interestingly, this ties into certain innate beliefs regarding physics intelligence. This is demonstrated by research showing that a physics graduate admissions committee retained stagnant beliefs regarding innate intelligence [16]. This has far implications about how such a fixed mindset manifests in prejudice beliefs about who is likely to succeed in physics — those with innate talent, often aligning with the population who are largely white and male. Ultimately, such innate beliefs within physicists who comprise the physics community will also result in general student endorsement of stagnant beliefs as well. It is important to foster a growth mindset in any physics classroom, as to begin dismantling these preconceived beliefs about innate physics intelligence.

B) Research Questions

Academic mindsets revolve around definitions of success, and ability to respond to challenges. We will be exploring student's mindsets and subsequent behaviors by asking these questions:

- Do introductory physics students have a fixed or growth mindset when it comes to physics?
- How do students' fixed or growth mindsets in introductory physics influence how they approach challenging physics questions?
- Does the level of fixed or growth mindset improve outcomes for students?

IV. Methodology

A) Overview

Ultimately, this project is an exploratory model which intends to obtain both qualitative and quantitative data on students' fixed or growth mindsets through mixed methods. The approach will utilize a three-pronged method to get an in-depth, yet large scope of understanding about students' motivations for learning. This will be achieved by conducting several interviews supplemented with a follow-up email for extensive understanding of students' mindsets. Interviews will have hidden intentions for mindset research while the follow-up email will reveal the investigative study. For broader understanding, a Likert scale will be distributed to all students within the class. The objective of the data collection is to (a) obtain student dialogue describing differing responses to the challenges presented by the course and (b) determine a comprehensive

scheme that can depict and categorize students' mindset beliefs.

B) Development of Interview Process

Interviews were conducted on 12 students within the PH20x series during the Winter term PH202 course. Thus, students had the chance to process their experiences within the previous Fall term PH201 course. Students were recruited on a voluntary basis, through in-class and email announcements. Participation was voluntary throughout the whole process. Out of the students who participated in the interview portion of the study, seven participants identified as female, and five participants identified as male.

As stated previously, mindset may be conceived as a stable dimension, with students labeled as having a certain mindset through all context or fields of intelligence. Oversimplification of a student's mindset as either fixed or growth mindset may be commonplace in general mindset research as well [4]. Because we are emphasizing the contextual and extensive understanding of students' motivations and beliefs, interviewing was a natural decision for the objective of understanding contextual dialogue.

Interviews were semi-structured. Although there were a number of preset questions that were prepared beforehand, other inquiring questions were asked during the interview to get the interviewee comfortable with the process or to probe more deeply into their story or beliefs. All questions were created to probe student beliefs about physics intelligence and response to challenge either directly or indirectly. As mindset can only be studied as a result of a challenge event, many of the questions attempted to set the context within a challenge event. Some questions were inspired by Angie Little's research, which had created a novel set of coding schemes for context-dependent interviews of students in a physics introductory course [1]. Questions are linked in the appendices (pg. 33).

C) Likert Scale

Likert scale survey questions are a suitable tool for a broader view of the mindset landscape within the introductory physics classroom. It is a standardized method used in lots of mindset research [17]. It can appropriately reveal the variation and spread of mindset within the student population of the PH202 course. Thus, a two-item survey was utilized to reveal a student's mindset regarding their physics intelligence (Table 1).

Table 1: A two-item Likert scale survey and potential answers

Item	Answers
<p>1. Think of a time you had a particularly difficult challenge homework. After a good amount of progress on the challenge problem. How much do you agree with the statement below about what you would do at this point?</p> <p>I will take many extra measures to try this problem again, such as going to the Worm Hole or LAHHH, interacting with the class channel on Teams, or reviewing all related concepts to get a better understanding.”</p>	<p>0. No answer</p> <p>1. Strongly disagree that I will take many extra measures to try again.</p> <p>2. Moderately disagree that I will take many extra measures to try again.</p> <p>3. Slightly disagree that I will take many extra measures to try again.</p> <p>4. Slightly agree that I will take many extra measures to try again.</p> <p>5. Moderately agree that I will take many extra measures to try again.</p> <p>6. Strongly agree that I will take many extra measures to try again.</p>

2. According to Dweck, a leading researcher on mindset theories, the definition of a fixed mindset is that a person will believe that a “highly valued personal attribute, such as intelligence, is a fixed, non malleable trait-like entity.” Contrasting this, the definition of a growth mindset is that an “attribute is a malleable quality that can be changed and developed.”

0. No answer
1. Strongly identify with a fixed mindset.
2. Moderately identify with a fixed mindset.
3. Slightly identify with a fixed mindset.
4. Slightly identify with a growth mindset.
5. Moderately identify with a growth mindset.
6. Strongly identify with a growth mindset.

With these definitions in mind, which of the following options do you feel about yourself?

This is considered a standardized way of obtaining mindset data. However, it should be noted that Likert scale questions can oversimplify mindset data and may not capture valuable contextual clues. Moreover, confirmation bias may be more prevalent in Likert scale survey answers. However, these surveys can be used to quantify mindset data and uncover the spectrum of mindsets present within the large student population enrolled within the PH202 course.

D) Follow-up Email

Interviewed students were asked to consider their mindset in a follow-up email after the PH202 term had ended. Interviews were conducted with hidden intentions and mindset research was not revealed to be the main investigative study. When students were prompted to respond to the follow-up email, they were made aware of the investigative study on mindset. This was intended to allow students to acknowledge their mindset versus transcript, mimicking a meta-cognitive activity. Questions asked in the follow-up were:

- Could you state what mindset you identify with regarding physics intelligence (based on figures provided illustrating the difference between a growth and fixed mindset)?
- Do you think your current identification was reflected in your beliefs/actions/complaints described within our talk?
- Do you think there was a difference, and if so, why?
- Do you think that you identify differently for other courses? If so, why do you think this is?

V. Results and Discussion

Analysis of Qualitative Data

Transcripts for each student were obtained from the interview process, with each student having an associated pseudonym. Analysis of the transcripts occurred according to Little's Codebook, who had created a novel set of coding schemes for context-dependent interviews of students in a physics introductory course [1]. The codebook categorized phrases in the transcript into two different subsections: Belief statements and learning orientation statements. Each phrase associated with either category was then connected to a Priori code, as listed in Little's Codebook. The codes allowed for analysis

of a student's associated emotions and/or responses to each question. Each phrase was subsequently identified as leaning towards a fixed or growth mindset. Certain groupings, narratives, and themes were then curated from the collection of statements associated with the Priori codes, allowing for an illustration of students' varying experiences within the course.

A) Belief Statements

After identifying phrases within general belief categories, the phrases were connected to belief Priori codes: Phrases which contained "naturally talented", "smart", or any synonym that closely resembled that. Little had described these words as "selected synonyms." She also created a category, "nearby belief statements," which encompasses all phrases indicating a growth or fixed set of beliefs (i.e. motivations, attributions of failure, or self-capability statements). Each word, phrase, or statement was indicated to be either used in a changeable or fixable way, as done by Little. Students were aligned with a fixed or growth mindset as a result of the compilation of their belief statements.

B) Learning Orientation

Response to challenge can be characterized by a student's learning orientation, either mastery or performance-based orientation [18]. Little created coding schemes to detect such responses. In the literature, a student who has a mastery-oriented response will gladly accept challenges that can aid in growth towards mastery. On the other hand, individuals who have performance-oriented response attempt to document their competencies and intelligence, which typically result in avoidance of challenge. However, these students can also accept and persist through challenges if they feel they will succeed, and their abilities unquestioned. When these individuals lack confidence in their abilities, they will avoid, procrastinate, or possibly cheat in challenging situations that might make them appear incompetent. These behaviors can lead to a sense of learned helplessness. Students were aligned with a fixed or growth response as indicated by the compilation of phrases associated with mastery or performance-based learning orientations.

C) Groupings of Mindset

Analysis revealed the nuance of student beliefs and response to challenge, unveiling surprising results from the binary expectations of mindset and response. Each student was identified with a fixed or growth mindset, and fixed or growth response, as determined through an overall compilation of coded phrases (pg. 36). Although there were examples of consistency between mindset and expected response, analysis indicated some students had a discrepancy between mindset and expected response. For example, many students had a fixed mindset with responses seemingly more aligned with someone who would have a growth mindset. As a result, groupings were created to encompass all students within mindset categories. There were three major groupings of mindset that were observed within the transcripts (Table 2):

- 1) Fixed mindset, Fixed response;
- 2) Fixed mindset, Growth response;
- 3) Growth mindset, Growth response.

Although there were only these 3 groupings that were observed, we can predict there to be a fourth grouping that denotes a student with a growth mindset and a fixed response.

Table 2: Grouping indication for each interviewed student

Student	Grouping
Susan	1
Wendy	1
Peter	1
Tom	1
Paul	1
Ben	2
Emily	2
Selena	2
Michaela	2
Alice	2
Cindy	3
Rob	3

1. *Fixed Mindset, Fixed Response*

Someone who has a fixed mindset and fixed response regarding physics intelligence is consistent with the way that their mindset informs their avoidant-like response to challenge. As these students generally encompass motivations more so aligned with documenting success or intelligence, it is expected that they shy away from any challenge that confronts their beliefs about their intelligence.

“I’m very like avoidant. Like avoidant anxious, and so it like makes me want to push them aside and do them last minute which isn’t a good idea.” - Susan

In Susan’s transcript, she relates the inherent nature of applied math within physics as the reason for her struggles and a source of discomfort. Often, this discomfort emotion leads to a level of avoidance. She is attracted to questions that are more “A level,” and wants to coast through problems rather than appreciating the challenge presented. Her response to challenge is thus consistent with someone who has a fixed mindset, and who will be disinclined to tackle challenges.

2. *Fixed Mindset, Growth Response*

Someone who has a fixed mindset, with a growth response regarding physics intelligence will have motivations to document success/intelligence and attribute failure to their intelligence. However, their transcripts have identified responses that align with a mastery orientation, where they will persevere through a problem and give significant

effort even in the case of challenge. These types of students classified the majority of students that were identified.

“Yes, you can understand it and not get that A, but at the same time, then I don’t feel successful, so, if I understand the material and then get the A, then I feel successful, which is great, but yeah I just feel really defeated if I don’t get a good grade on tests and stuff like that.” - Selena

“When I was younger, I always felt like ‘Oh shortcuts are the way to go. I can just like look it up on Chegg, you know, like that, write it down, and then now... it’s a deep breath and then kind of like go through it again. Maybe I’ll take like a you know snack break or something like that.” - Selena

In Selena’s transcript, statements such as the one listed on top, notably align with a fixable quality. Throughout the transcript, Selena more so attempts to document her success through grades, emphasizing the ‘A’ that she got for the PH201 course last term. She also states that an A is her ultimate indicator of success. However, her response to challenge aligns with someone who would have a growth mindset, with emphasis on persistence and significant effort, especially as required if challenges are presented. She has found success as a result of the amount of effort that she put forth.

3. Growth Mindset, Growth Response

A student who has a growth mindset and who exhibits a growth response is consistent with their belief and the response. Their motivations and effort in the course relate to a mindset which prioritizes understanding and mastering of topics and is reflective in responses showing perseverance and significant effort.

“Well if you don’t put the work in to tackle difficult concepts, then you’ll never learn. It’s like trying to lift weights, but you don’t... you’re trying to get stronger, but you don’t want to go to the gym and lift weights. Yes, it requires effort and struggle to become better at anything in life.” - Rob

In Rob’s transcript, he values understanding and mastery of the material, which reflects in his openness to challenge events. Rob explicitly states effort and practice are necessary to succeed, and attributes his academic performance within the course to perseverance, rather than intelligence or intrinsic factors.

4. Growth Mindset, Fixed Response

Although this grouping was not identified within the students that were interviewed, we can predict that this grouping to be present within a larger pool of interviewed students. These students have a mindset aligned with prioritizing understanding, however, will exhibit responses indicating that they give up in the face of challenge.

Although only a couple of students were mentioned in this section, every interviewed student has an associated narrative and grouping found in the appendices section (pg. 26). Some noticeable results include the discrepancy in the binary expectations of mindset and response to challenge. There could be a couple factors which may point to this occurrence and certain identified themes which explain this discrepancy.

D) Theme of context-dependency

Context-dependency was seen throughout the transcripts. Situational context can influence a student's mindset towards either direction. The discrepancy that was observed in mindset beliefs versus response could be attributed to situational context. Some students acknowledged within the transcript and the follow-up email having differing motivations depending on the course or material. Within the transcripts, it was observed that the difference in identification across other courses versus physics may be attributed to context-dependency as well.

Many students attributed applicability to be a large determinant in their responses that were identified within their transcripts. For example, according to Emily, she believes in her capability to achieve this success and cites repetition and practice as the key to attaining it. Although acknowledging this, she states that her motivations for effort are primarily to achieve good grades. As physics is not as applicable to her future studies and interests, she may not prioritize understanding as compared to her classes within the biological life sciences.

“Since I'm not like going into a physics related field, I'm not worried about my long-term retaining the information.” - Emily

This was also reflected in Tom's transcript as well, as he finds the applicability of the course to be minimal. It seems that under emotions of discomfort when facing a difficult problem, he is quick to give up. He states that he puts as minimal effort into the class as possible, enough to maintain good grades. Similar to Emily, Tom prioritizes his grades rather than understanding, although notes that for other classes where he aligns with a growth mindset, relevance to his future or interest are large determinants. Contextual dependency seems to affect both mindset and response, and applicability to the future was seen as the greatest influence in transcripts showing contextual dependency.

“...also something that is not going to be super applicable for me... so it was just going to be a grind...So I'm wanting to do physical therapy so pretty much everything after like the first two weeks of class I don't care about.” -Tom

E) Theme of conditional-dependency

Another theme identified in the transcript was the idea of conditional-dependency, which can be described as a mindset with a large component of dependency on success or failure which dictates the response to challenge. In this sense, it is unclear whether the mindsets identified in the transcripts are a short-term or temporary state, which may be inaccurate to the beliefs or motivations that they have generally.

Selena is a student who shows indications of conditional dependency within her transcript. We can appreciate that Selena has acquired some habits that are associated with a growth mindset, such as perseverance and self-belief. However, this may be due to the newfound success achieved within the course, as she exhibits beliefs that are consistent with a fixed mindset. There were many different instances of documenting results, as well as endorsing a belief in natural talent. Her response to challenge, associated satisfaction, and success, are based on the newfound success documented by her grades, which indicates a mindset that is conditionally-dependent – specifically on her grades and success.

“Everyone told me I was gonna fail it. I got an A last term, and I was like ‘This is awesome. I love it,’ and all my friends that are like smarter than me are like, ‘Omg you got an A,’ like, ‘I know right!’” – Selena

“Yes, you can understand it and not get that A, but at the same time, then I don’t feel successful, so, if I understand the material and then get the A, then I feel successful, which is great, but yeah I just feel really defeated if I don’t get a good grade on tests and stuff like that.” – Selena

Analysis of Likert Scale Data

A) Population Likert Scale Data

Students enrolled in the course took a two item Likert scale survey (Table 1) and distribution of responses across the mindset scale was recorded (Fig. 1). It should be noted that Item 1 characterizes response to challenge, while Item 2 characterizes mindset. For Item 1, the figure shows the large majority of students identifying with a growth response. The majority of those who identified with a growth response aligned with a moderate growth response compared to other growth categories (Fig. 1). For Item 2, a greater number of students identified with a growth mindset. Within those who identified with a growth mindset, the majority aligned with a moderate growth mindset compared to other growth categories.

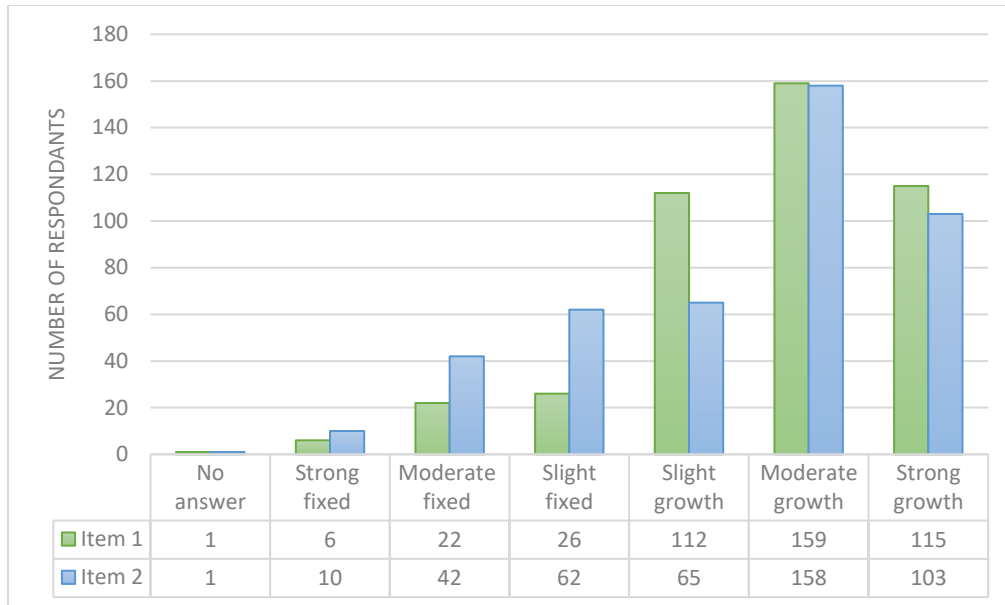


Figure 1: Population data of all students enrolled in the PH202 course. Student mindset self-identification as concluded from a two-item Likert scale survey (Table 1).

Descriptive statistics were performed on each item on the survey for the overall population of students enrolled in the PH202 course (Table 3). Results for each item are presented as means, standard deviations (SD), and coefficient of variation (Table 3).

Table 3: Descriptive statistics for a two-item Likert scale survey on population and sample data.

Item	Data Set	Mean (SD)	Coefficient of Variation	Standard Error of Mean
1. I will take many extra measures to try this problem again, such as going to the Worm Hole or LAHHH, interacting with the class channel on Teams, or reviewing all related concepts to get a better understanding.”	Population data	4.67 (1.17)	0.25	N/A
	Sample of Interviewed Students	4.92 (1.44)	N/A	0.33
2. According to Dweck, a leading researcher on mindset theories, the definition of a fixed mindset is that a person will believe that a “highly valued personal attribute, such as intelligence, is a fixed, non malleable trait-like entity.” Contrasting this, the definition of a growth mindset is that an “attribute is a malleable quality that can be changed and developed.”	Population Data	4.42 (1.37)	0.31	N/A
	Sample of Interviewed Students	4.92 (0.9)	N/A	0.40

Coefficient of variation (CV), a standardized measure of the dispersion of data points around the mean, was determined for the population data. Analysis revealed values in the data are set close to the mean and each other. A low value indicated small variation in the population data with scores < 1 for both items (Table 3). The means for both items in the survey, in conjunction with a low CV, indicate that most students in the course believe that they align with a growth mindset or response, with an average identification between a slight and moderate growth mindset or response.

B) Comparative Sample of Interviewed Students to Population

Interviewed students took the same two-item Likert scale survey as the population of students in the PH202 course and the distribution of responses across the mindset scale was recorded (Fig. 2). For Item 1, the figure shows the large majority of interviewed students identifying with a growth response (Fig. 2). The majority of those who identified with a growth response aligned with a strong growth response compared to other growth categories. For Item 2, a greater number of interviewed students identified with a growth mindset rather than fixed (Fig. 2). Within those who identified with a growth mindset, the majority aligned with a moderate growth mindset compared to other growth categories.

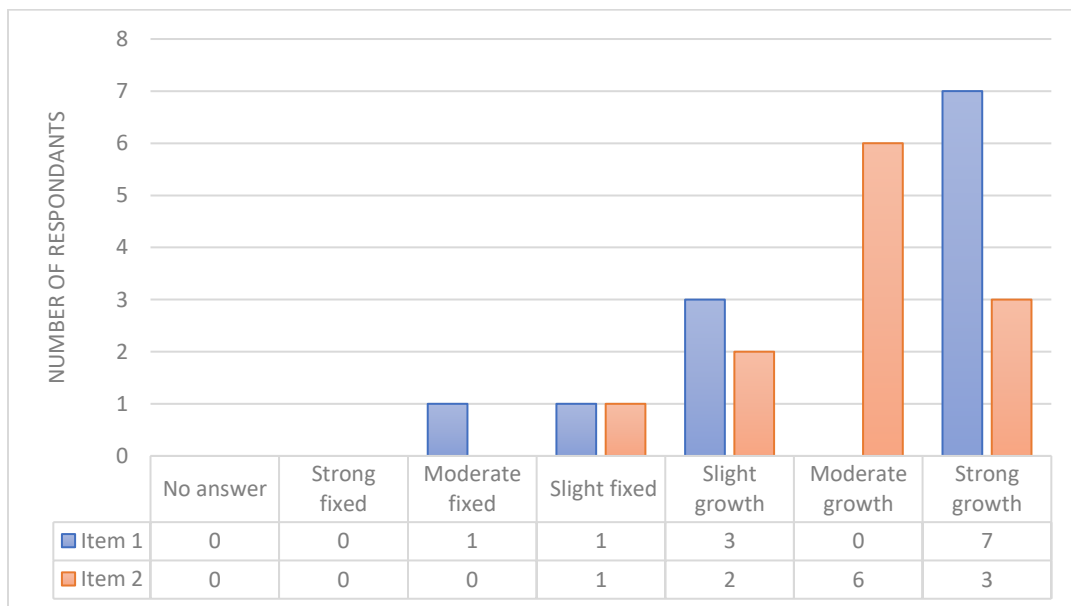


Figure 2: Sample data of students who volunteered in the interviewing portion of the study - Student mindset self-identification as concluded from a two-item Likert scale survey (Table 1).

Descriptive statistics were performed on each item on the survey for the sample of interviewed students enrolled in the PH202 course with determination of standard error of means (Table 3). To determine whether there was a large influence of volunteer bias in the students that participated in the interview, a standard error of mean (SEM) estimated the distribution of sample means as compared to the population data. This gave values which either indicate a far or close distribution of the sample data around the population mean. Analysis, as seen in Table 2, indicates a relatively close distribution of sample data around the population mean for Item 1. It is inferred that the sample of interviewed

students with a sample mean of 4.92 can be thought of as relatively accurate to the population data, as it is within the one standard error of the population mean 4.67 ± 0.34 (SE). For Item 2 of the survey, the sample mean 4.92 is within two standard errors of the parametric mean. This could very much have been influenced by the small sample size of the interviewed students. The students who volunteered may have had slight bias towards a higher growth mindset score as compared to the population, as suggested by data from Item 2.

C) Student Mindset Indication in Likert Scale Data as compared to Interviews

Table 4: Summary of student’s mindset and response indication as derived from Likert scale data and interview analysis

	LIKERT SCALE (ITEM 2) - MINDSET INDICATION	LIKERT SCALE (ITEM 1) - RESPONSE INDICATION	INTERVIEW - MINDSET INDICATION	INTERVIEW - RESPONSE INDICATION
SELENA	Growth mindset: “Moderately identify”	Growth response: “Strongly agree”	Fixed mindset	Growth response
MICHAELA	Growth mindset: “Moderately identify”	Growth response: “Slightly agree”	Fixed mindset	Growth response
SUSAN	Growth mindset: “Strongly identify”	Growth response: “Strongly agree”	Fixed mindset	Fixed response
WENDY	Growth mindset: “Strongly identify”	Growth response: “Slightly agree”	Fixed mindset	Fixed response
ALICE	Fixed mindset: “Slightly identify”	Growth response: “Strongly agree”	Growth mindset	Growth action
BEN	Growth mindset: “Slightly identify”	Fixed response: “Slightly disagree”	Fixed mindset	Growth response
EMILY	Growth mindset: “Moderately identify”	Growth response: “Strongly agree”	Fixed mindset	Growth response
CINDY	Growth mindset: “Moderately identify”	Growth response: “Strongly agree”	Growth mindset	Growth response
PETER	Growth mindset: “Moderately identify”	Growth response: “Strongly agree”	Fixed mindset	Fixed response
TOM	Growth mindset: “Moderately identify”	Fixed response: “Moderately disagree”	Fixed mindset	Fixed response
PAUL	Growth mindset: “Slightly identify”	Growth response: “Slightly agree”	Fixed mindset	Fixed response
ROB	Growth mindset: “Strongly identify”	Growth response: “Strongly agree”	Growth mindset	Growth response

Of note, Likert scale data probed students’ self-perceived thoughts as related to their academic mindsets. On the other hand, interviews attempted to align student transcripts with an academic mindset as a result of contextual evidence. Likert scale data did not seem consistent with the mindset indications gleaned from the interviews, as summarized in Table 4. It is expected that majority of students lean towards a growth mindset as presented in the Likert Scale data summarized in Table 3. However, most students who participated in the interview, many of whom self-identified with a growth mindset in the Likert scale, were more aligned with a fixed mindset during the interview portion. Despite this, SEM values suggest no heavy influence of volunteer bias, as the interviewed

students are within the standard error observed in the general population of students in the PH202 course.

D) Likert Scale Summary

In summary, Likert scale analysis indicated low variation in self-identification. Most students in the course identify with a growth mindset or response, with average alignment between a slight and moderate growth mindset or response. Analysis also indicated no heavy influence of volunteer bias between the sample of interviewed students compared to the population.

Overall, Likert scale data was not consistent with the mindset and response indications from the interviews. The Likert scale survey, although describing the variation and spread of mindset within the student population of the PH202 course, was alone not able to give us the contextual evidence that is necessary for a more accurate illustration of a student's mindset. Such discrepancies illustrate the importance of using both methods in conjunction with one another to fully illustrate a picture of a student's mindset. It is also important to note potential influences stemming from students as well, such as slight influence of volunteer bias, confirmation bias, or a distortion of self-perception.

VI. Take-aways

A) Fostering a Growth Mindset

Applicability seemed to be a large theme within the analysis. In students that believed that the course provided minimal applicability, such as in Tom and Wendy, it manifested as negative affect and behavior in the course. This was especially exacerbated when the students did not achieve the success that they had hoped. Those who believed applicability of the course to be minimal but who did achieve success, showed responses which were aligned with a growth mindset as they were willing to put in significant effort to attain the grade that was required. However, mastery and retaining of information were placed on the wayside. Thus, the interplay of context-dependent and conditionally dependent themes are strongly present within the transcripts, and the complexity of which suggests that more interviews are required to elucidate the notion of either theme. However, it is intriguing that the lack of both applicability and success, notions which were explored by context and conditionally dependent themes, can often lead towards regression into a fixed mindset and a helplessness response seen within some students' experiences. This is summed up by Wendy, who states that "most things have a learning curve but that the curve can be quite steep if you have no interest in the topic," making it difficult to adopt a growth mindset.

Fostering a growth mindset becomes a balance, as continual, non-yielding effort, such as in the case of Alice, seemed to drive her towards a fixed mindset even though she started the series with a baseline growth mindset. Allowing for some struggle with the class material is necessary, although emphasizing consequent progress as a result of significant effort is also important to foster a growth mindset and build confidence in student's beliefs about their ability to tackle the challenges faced in the course.

VII. Conclusion & Future Research

The goal of the study was to analyze student experiences within the course, with the hopes of presenting narratives and a grouping scheme able to illustrate how mindsets play a role in a student's perceived satisfaction. Angie Little's research and work had provided a coding scheme as to analyze dialogue and transcripts for contextual evidence on mindset [1]. Consistent with prior research in the field of education, students that engaged in a growth mindset seemed to show greater academic perceived satisfaction as compared to their peers with a fixed mindset [10, 19]. Mindset beliefs were also revealed to be complex and dynamic however, and novel interpretation of themes of context and conditional dependency were also found resulting from this study.

It is subsequently critical to explore how course structure, material, and teaching can be maximized to foster a growth mindset. Although the study was limited in operational scale and analysis of material, it is a jumping off point for further adjustments to methodology and thematic analysis in order to explore the interplay between contextual and conditional dependency within mindset.

This process did not result in interventionist methods, as is the current theme in mindset research. However, it is the criteria for such change. Figuring out contextual factors and themes give way to departmental understanding of its students, forging the path for later implementation of curriculum or course structure remodeling steps to better facilitate learning and engagement.

References

- [1] Little, A.W., Sawtelle, V., & Humphrey, B. (2016). Mindset in Context: Developing New Methodologies to Study Mindset in Interview Data. 204-207. 10.1119/perc.2016.pr.046.
- [2] Kapasi, A., & Pei, J. (2022). Mindset Theory and School Psychology. *Canadian Journal of School Psychology*, 37(1), 57–74. <https://doi.org/10.1177/08295735211053961>
- [3] Dweck, C. S., Chiu, C., & Hong, Y. (1995). Implicit Theories and Their Role in Judgments and Reactions: A World from Two Perspectives. *Psychological Inquiry*, 6(4), 267–285. <http://www.jstor.org/stable/1448940>
- [4] Dweck, C.S. *Edu. Week*. 35, 20, 24 (2015).
- [5] Nagaoka, J., Farrington, C.A., Roderick, M., Allensworth, E., Keyes, T.S., Johnson, D.W., & Beechum, N.O. (2013). Readiness for College: The Role of Noncognitive Factors and Context.
- [6] Hochanadel, A.J., & Finamore, D. (2015). Fixed And Growth Mindset In Education And How Grit Helps Students Persist In The Face Of Adversity. *Journal of International Education Research*, 11, 47-50.
- [7] Yeager, D. S., Hanselman, P., Walton, G. M., Murray, J. S., Crosnoe, R., Muller, C., Tipton, E., Schneider, B., Hulleman, C. S., Hinojosa, C. P., Paunesku, D., Romero, C., Flint, K., Roberts, A., Trott, J., Iachan, R., Buontempo, J., Yang, S. M., Carvalho, C. M., Hahn, P. R., ... Dweck, C. S. (2019). A national experiment reveals where a growth mindset improves achievement. *Nature*, 573(7774), 364–369. <https://doi.org/10.1038/s41586-019-1466-y>
- [8] Claro, S., Paunesku, D., & Dweck, C. S. (2016). Growth mindset tempers the effects of poverty on academic achievement. *PNAS Proceedings of the National Academy of Sciences of the United States of America*, 113(31), 8664–8668. <https://doi.org/10.1073/pnas.1608207113>
- [9] Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: a longitudinal study and an intervention. *Child development*, 78(1), 246–263. <https://doi.org/10.1111/j.1467-8624.2007.00995.x>
- [10] Carvalho, E., & Skipper, Y. (2019). A two-component growth mindset intervention for young people with SEND. *Journal of Research in Special Educational Needs*.
- [11] Burnette, J. L., Hoyt, C. L., Russell, V. M., Lawson, B., Dweck, C. S., & Finkel, E. (2020). A Growth Mind-Set Intervention Improves Interest but Not Academic Performance in the Field of Computer Science. *Social Psychological and Personality Science*, 11(1), 107–116. <https://doi.org/10.1177/1948550619841631>
- [12] Li, Y., & Bates, T. C. (2019). You can't change your basic ability, but you work at things, and that's how we get hard things done: Testing the role of growth mindset on response to setbacks, educational attainment, and cognitive ability. *Journal of Experimental Psychology: General*, 148(9), 1640–1655.
- [13] Da Fonseca, D., Cury, F., Bailly, D., & Rufo, M. (2004). Role of the implicit theories of intelligence in learning situations. *L'Encéphale*. 30. 456-63.

- [14] Mulvey, P.J., Nicholson, S., Pold, J. (2021). Trends in Physics PhDs: Results from the 2019 Survey of Enrollments and Degrees and the Degree Recipient Follow-Up Survey for the Classes of 2017 and 2018. AIP Statistical Research Center.
- [15] Deiglmayr, A., Stern, E., & Schubert, R. (2019). Beliefs in "Brilliance" and Belonging Uncertainty in Male and Female STEM Students. *Frontiers in psychology*, 10, 1114. <https://doi.org/10.3389/fpsyg.2019.01114>
- [16] Scherr, R.E. (2017). Fixed and growth mindsets in physics graduate admissions. *Bulletin of the American Physical Society*, 2018.
- [17] Rammstedt, B., Grüning, D., Lechner, C. (2021). Measuring Growth Mindset: A Validation of a Three-item Scale and a Single-item Scale in Youth and Adults. <https://doi.org/10.31234/osf.io/rs43g>.
- [18] Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology*, 54(1), 5–12. <https://doi.org/10.1037/0022-3514.54.1.5>
- [19] Diao C., Zhou W., Huang Z. (2020). The relationship between primary school students' growth mindset, academic performance and life satisfaction: the mediating role of academic self-efficacy. *Stud. Psychol. Behav.* 18 524–529.

SELENA

FIXED MINDSET BELIEFS; PROGRESSION TOWARDS GROWTH MINDSET

ACTIONS

CONDITIONAL-DEPENDENCY

Selena previously took a high school physics class that influenced her expectations coming into the course. In this high school physics class, she reports having experienced failure and having to drop out of the class. It seems that this has influenced her beliefs about her self-capability. She implies that she is not naturally good at physics compared to her peers and must work harder than others.

"I always had to like... you know tried to study more."

Selena more so attempts to document her success through grades, emphasizing the 'A' that she got for the PH201 course last term. She also states that an A is her ultimate indicator of success. It seems that she went into the course not believing in her abilities to achieve success as a result of her previous experience in a physics class. She also notes that others had the same expectations of her. She defied these expectations and instead, got an A last term. She states having found a lot of enjoyment out of the course, and attributes her success to a change in mindset. She notes major effort and perseverance in the course.

We can appreciate that Selena has acquired some habits that are associated with a growth mindset, such as perseverance and self-belief. This may be due to the newfound success that was achieved. However, she exhibits beliefs that are consistent with a fixed mindset, as there are many different instances of documenting results, as well as endorsing a belief in natural talent. This indicates a mindset that is conditionally-dependent, who will express a growth mindset specifically dependent on her grades and success.

"Yes, you can understand it and not get that A, but at the same time, then I don't feel successful, so, if I understand the material and then get the A, then I feel successful, which is great, but yeah I just feel really defeated if I don't get a good grade on tests and stuff like that."

In general, her actions show that she has a growth mindset, because she puts in a lot of effort (i.e., doesn't take shortcuts, seemed to result in a higher GPA). However, her success is purely based on being able to get an A: "You can understand it and not get that A, but at the same time, then I don't feel successful." Her satisfaction and success are based on the newfound success documented by her grades, which means that her growth mindset may be conditionally dependent - specifically on her grades and success.

MICHAELA

FIXED MINDSET BELIEFS; PROGRESSION TOWARDS GROWTH MINDSET

ACTIONS

Michaela describes having a love/hate relationship with physics. Specifically, she enjoys learning physics concepts, but is deterred from developing a passion due to the math heavy nature of the course. She does not

feel that she is a math type of person and has never been as confident in math like other topics. She doesn't believe that she will ever develop a passion for physics, as it is not her side of science, as compared to forensics. It seems that passion may be tied to her confidence in the topic.

"... I've never been as confident in math like all of my other classes, so it was just kind of like math on steroids."

Although physics is not her passion, Michaela prides herself in learning in general, and believes that both understanding and grades are her metrics of success. Consistent with this, Michaela does not fixate on documenting her grades. It seems she puts effort into learning into every topic, even if it is not her passion.

"I want to be able to learn, and I want to be able to accomplish things without the help of others."

In the post interview follow-up, Michaela states that she identifies with having a growth mindset in all her academic classes, but especially within the physics course. The assignments and grading of the assignments allow her to work through the equations and practice perseverance with complicated problems. She believes that her current identification was reflected in her transcript.

SUSAN

FIXED MINDSET BELIEFS; FIXED MINDSET ACTIONS

Susan has previous associated notions regarding math. She states that she struggles with math, which has translated into her struggles with physics. She relates the inherent nature of applied math within physics as the reason for her struggles and a source of discomfort. Often, this discomfort emotion leads to a level of avoidance. She is attracted to questions that are more "A level," and wants to coast through problems rather than appreciating the challenge presented.

"I'm very like avoidant. Like avoidant anxious, and so it like makes me want to push them aside and do them last minute which isn't a good idea."

She states that her metric of success is understanding. However, she states that she puts effort into the physics course because she wants a good grade. The positive emotions that were identified within the transcript were often associated with talking about achieving a high score in class.

WENDY

FIXED MINDSET BELIEFS; FIXED MINDSET ACTIONS

Wendy has complaints about the workload, course structure, and instructors, specifically regarding the large volume of assigned work and flipped classroom structure. She has many associated emotions of dislike and discomfort that were identified in the transcript associated with the complaints. Negative self-capability talk was identified within the transcript, associated with her ability to solve the challenges presented by the course.

“I have a difficult time with most of the challenge homeworks and almost every time like I get very down on myself and I... I find that I just talk very poorly to myself, it makes me feel stupid.”

Wendy also has instances of positive self-capability talk while referencing success attained in other courses. These positive emotions are often associated with documenting her success and attempting to reinforce her ability to get good grades and be a good student.

“...I've taken all sorts of classes and I guarantee I wasn't interested in all of it but I'm a good student. I like to do well in school.”

In the post interview follow-up, Wendy states that she identifies with a growth mindset regarding physics. She acknowledged that the frustrations within the class may have made her seem that she had a fixed mindset, but states that is not the case. Of importance, she notes that “most things have a learning curve but that the curve can be quite steep if you have no interest in the topic.” She states that the course structure and environment, led her to believe in negative self-capability statements and that she was bad at physics, which may have aligned with a fixed mindset. She states that she now has a growth mindset, although she had to overcome a fixed mindset on her own, citing that it would be nice for a classroom to foster a growth mindset.

BEN

FIXED MINDSET BELIEFS; PROGRESSION TOWARDS GROWTH MINDSET

ACTIONS

He enjoys learning physics concepts but is deterred from developing a passion due to the math heavy nature of the course. When talking about challenging problems, instances of negative self-capability talk and negative emotions were identified. What was unique was that Ben states that he appreciates the challenge homeworks as an opportunity to learn, more so than the other homeworks that have been assigned, as it allows for practice and prevents him from guessing and checking. It is noted, however, that Ben often utilizes shortcuts as a starting point for learning.

“I was kind of just annoyed at myself. Like I felt like I should have gotten the material.”

Ben states that his reasons for putting in effort into the course is purely for the grades, although notes that for other courses, both grades and understanding were reasons for putting effort into learning. He does not get deterred from facing challenges and instead, has a more determined outlook to finish the assignment and understand the topic. Although dissuaded with his capability with physics, determination to succeed in the course is still present.

In the post interview follow-up, Ben states that he identifies with a growth mindset regarding physics, which he believes was demonstrated when he stated that the challenge homeworks are an opportunity to learn.

EMILY

FIXED MINDSET BELIEFS; PROGRESSION TOWARDS GROWTH MINDSET

ACTIONS

CONTEXT-DEPENDENCY

Emily does not identify as being a physics person. She enjoys learning physics concepts but is deterred from developing a passion due to the math heavy nature of the course, and states that math is not her particular interest as compared to biological life sciences. Although Emily does not particularly enjoy math, she has found this course to be less than difficult compared to the expectations that she had come in with. There were no instances of negative self-capability talk related to the difficult problems faced in class.

For Emily, her self-perceived success is determined solely by her grades, as she states it is important for her to maintain a high GPA as required for her higher education goals. She believes in her capability to achieve this success and cites repetition and practice as the key to attaining it. It seems that her mindset is context dependent. As physics is not as applicable to her future studies and interests, she may not prioritize understanding as compared to her classes within the biological life sciences field.

“Since I’m not like going into a physics related field, I’m not worried about my long term retaining the information.”

In the post interview follow-up, this was confirmed. Emily states that she identifies with a growth mindset for all the courses, although is not particularly invested in a growth mindset for physics as she is for other subjects. Emily states that the intensity of her growth mindset fluctuates depending on the amount of interest that has for it. She cites that she does not plan on continuing any studies within the subject after meeting the requirements and doesn’t feel the need to put in as much energy towards it. As such, she puts in effort to attain the grades she wants, with minimal effort as needed. She believes that this mindset was reflected in the transcript.

CINDY

GROWTH MINDSET BELIEFS; GROWTH MINDSET ACTIONS

Cindy does not identify as being a physics person, as related to the math heavy course. However, Cindy acknowledges her self-capability to improve within the course topic, which she believes is due to the way that the course structure is designed, allowing for her to more easily digest the topics.

“I think some of them have helped me learn. Like just having to slog through a really complicated challenge homework like does help you out, but when you have two other ones, you have to do it's kind of like, it's either like you're going to spend all your time on the really hard one or you're just kind of like half ass the other two.”

Cindy prioritizes being able to understand the material rather than grades. She appreciates the importance of challenge as a tool for understanding, but notes this is true only when there is time to digest and attempt the problems.

PETER

FIXED MINDSET BELIEFS; FIXED MINDSET ACTIONS

CONTEXT-DEPENDENCY

Peter does not identify as being a physics person, which he believes boils down to whether a person is “less put off by math,” and whether they have interest in the subject matter. He also suggests that if physics was more applicable to his field of interest, he might be more invested in the topic.

“... if it was incorporated into a biology context, I would be more open to it.”

Peter believes that understanding is much more important to learning than grades but admits that he prioritizes grades for this course as it will affect his ability to get scholarships and achieve success down the road. He also acknowledges that there may be a discrepancy between getting a good grade and understanding. He states that in this course, he prioritizes grades and his understanding and mastery of topic is lacking.

Peter will respond to difficulty by giving up and does not actively go further than what is activities that are required.

“I feel like... I give up generally when I put in a lot of effort and it just ain't going nowhere. Then, like I just hit a point where it's like all right, like I just see the shortcut and then like that period can last for a bit of a while because I'm just drained.”

TOM

FIXED MINDSET BELIEFS; FIXED MINDSET ACTIONS

CONTEXT-DEPENDENCY

Tom finds that the applicability of the course to be minimal. It seems to affect his interest in the course negatively, and in turn, seems to lead Tom to align with a fixed mindset. He believes that physics concepts are interesting, but states that the math heavy procedures will not lend any direct applicability to his future. Under emotions of discomfort when facing a difficult problem, he is quick to give up. He states that he attempts to put minimal effort into the class as possible. In addition, his metric of success is grades, although notes that for other classes that he considers either relevant to his future or fun, his metric of success aligns more with that of a growth mindset.

“...also something that is not going to be super applicable for me... so it was just going to be a grind...So I'm wanting to do physical therapy so pretty much everything after like the first two weeks of class I don't care about.”

Interestingly, Tom considers himself a physics person, and states that he had previously considered majoring in physics and enjoys it. It brings up the questions why Tom seems to showcase a fixed mindset. In another revealing moment, Tom states that he enjoys learning, but the amount of work in addition to the other courses has caused burnout, which leads to the presentation of a similar mindset.

ROB

GROWTH MINDSET BELIEFS; GROWTH MINDSET ACTIONS

Rob's presentation of mindset aligns distinctly with a growth mindset. In the face of challenge, Rob does not feel frustrated, and proceeds forth with the difficulty by giving more hard work and significant time. He believes effort and struggle are required to become better, and embraces challenges, as long as it is not a high stakes.

"Well if you don't put the work in to tackle difficult concepts, then you'll never learn. It's like trying to lift weights, but you don't... you're trying to get stronger, but you don't want to go to the gym and lift weights. Yes, it requires effort and struggle to become better at anything in life."

Interestingly, Rob prioritizes grades, although he makes it obvious that understanding is also important to him. He describes feeling disgusted by those who don't have a basic understanding of their field, only to document their grades. This feeling is associated with being an older student, and not being a traditional student.

"I'm an older student so I don't have to be here and I'm not just here for the degree, but since I'm getting one, I wanted to retain as much as possible from the process."

It seems Rob has attained some level of perceived satisfaction, and believes that he has made great progress and believes his ability to tackle the challenges faced in the course.

ALICE

FIXED MINDSET BELIEFS; GROWTH MINDSET ACTIONS

CONTEXT-DEPENDENCY

Alice seems to love challenging courses, and views these courses as generally more rewarding. She prioritizes understanding and mastery within these courses. The same expectations were present when entering the PH20x series. However, she states that this course has caused her to spend such significant time without any improvements in understanding or mastery of the topics. In the face of difficulty, she will put in more hard work, such as attending all LAHHH and office hours, as well as reviewing topics before the course started. She still feels as if she has not achieved success and lacks understanding/mastery of the topics although on paper and on her grades, it may seem like it.

"I'm getting A's... I don't like... If you asked me to describe what I've learned so far, I could not coherently tell you things and it's the only class that I can't do that with."

It seems as if she has given up on feeling like she understands the concepts, but does not seem she has given up on putting in effort. As such, although she generally identifies with a growth mindset, it doesn't seem to attribute to her perceived satisfaction. It seems that Alice is changing towards a fixed mindset, especially because she states that there is a change from her mindset during the PH201 course and the PH202 course. Now she has many instances of negative self-capability talk, which recently started during this term.

"Defeat. I have adopted a lot of defeat. It doesn't feel like anything I do actually works."

In the post interview follow-up, Alice states that she has always identified with a growth mindset and had the fundamental belief that no matter any challenging situation, if effort is put into it, a person can make some sort of progress, even if it is small. However, she states that she put in significant effort into learning the material, and no understanding has been attained whatsoever. She states she has adopted defeat at this point, and now identifies with a fixed mindset.

PAUL

FIXED MINDSET BELIEFS; FIXED MINDSET ACTIONS

Paul prioritizes grades as his metric of success, although also hopes to retain the topics as well. He notes that more intuitive topics lead to a greater retention of the topics. Paul seems to give up after facing a discomfort emotion and states there is a cutoff threshold. Negative self-capability talk was identified in the transcript and instances of utilizing nearby intrinsic words are evident. Paul does not identify with a physics person, as he believes that a physics person is related to someone's math capabilities. He also states that he does not have a strong math background, which is tied to his belief that he is not a physics person, although he does appreciate his improvements in the topic.

Interview Questions	What I want to get out of this question	Potential Answers
<p>Q1. What does success in this course mean to you? Definition of success?</p> <p>Clarifications:</p> <p>a. Different definitions of success</p> <p>b. Provide context/scenarios</p> <p>c. Give example relevant to this question (grades)</p> <p>d. If there are multiple answers, can you rank what you deem to be most important?</p>	<p>Figure out what the student's metric of success is</p>	<p>-Grade letter</p> <p>-Learning/Challenge</p> <p>-Mixture</p>
<p>Q2. Have you achieved success and why or why not?</p> <p>Clarifications:</p> <p>Can you be specific about how well you have achieved success in your top 2 metrics of success?</p>	<p>Figure out the outcomes of their mindset - does it lead to more agency?</p>	<p>Answers will fall into category of internal locus of control or external locus of control</p>
<p>Q3. Scenario: Think of a time you had a particularly difficult challenge homework. Can you describe how you felt in that situation? (stay focused on this particular event)</p>	<p>Scenario will show how they perceive challenge- which is indicative of a certain mindset</p>	<p>-Defeated</p> <p>-Took it as opportunity to learn</p>
<p>Q4. Follow up Question: How did you go about dealing with the difficulty? Be specific.</p>	<p>How does the fixed or growth mindset influence how they approach the problem?</p>	<p>-Found a shortcut to finish the challenge homework</p> <p>-Take extra measures (such as going to wormhole) to try to understand</p>
<p>Q5. Can you describe your process for learning [insert physics topic]?</p>	<p>How does the fixed or growth mindset influence how they approach the problem?</p>	<p>-Defeated, won't try more than minimum effort</p> <p>-Take extra measures</p>

<p>Q6. Has your method of learning changed across terms or have you adapted your method of learning compared to other courses?</p>	<p>Did they adapt their mindset in order to adapt to the challenges of physics?</p>	<p>-Adapted to more of an growth or fixed mindset -No change</p>
<p>Optional: Q7. Why do you put effort into learning?</p>	<p>Answers can be used to assess what defines their motivation behind learning</p>	<p>-Get a degree -Results define them: Want to document their intelligence and talent -Long-term learning to understand topics and be challenged</p>
<p>Optional: Q8. Considering why you put effort into learning, have those reasons influenced your perceived satisfaction in this course? Clarifications: 1.Example: Didn't get grade you hoped for</p>	<p>Figure out the outcomes of their mindset - does it lead to greater perceived satisfaction?</p>	<p>-Yes, my mindset has allowed me to be satisfied -No, my mindset has caused stress and anxiety</p>
<p>Q9. After taking (1-2) semester(s) of physics, do you feel more confident in physics? i.e. improved understanding, improved content-learning,</p>	<p>Self-efficacy (agency) Do they feel more capable? More perceived satisfaction? Determine whether physics supports growth mindset/self-efficacy?</p>	<p>-More confident in ability to overcome the problem or challenges presented -No, my confidence is the same -No, my confidence has decreased due to evidence that I am not a "physics person"</p>
<p>Q10. Have you ever heard some people refer to themselves as a 'physics person' or 'not a physics person'? Why do you think someone comes to identify as one or the other? What are your own feelings about physics? Is math something that you have to be naturally good at to major in it in college?</p>	<p>Determine whether physics is something that a person must be naturally good at</p>	<p>-A "physics person" is someone who is naturally talented -There is no type of "person", just depends on the effort and developing of skills</p>

<p>Q11. Recall the [Insert Physics topic]. On a scale from 0-->10 with 0 being ‘that was kind of boring’ 10 being ‘that was the most interesting part of class ever!’, and 5 being neutral, where would you place your interest level for that topic? Why did you choose that number to describe your interest in this topic?</p>	<p>Possibly glean info about whether interest is due to wanting success in easy or low-effort tasks or because view it as an opportunity to learn</p>	<p>Words that are synonymous with “naturally good”, “easy”, or “opportunity to learn”</p>
<p>Q12. In that unit, did you have an experience where something seemed very tough or impossible to understand at first but then you came to better understand it?</p>	<p>Evidence of challenge faced, and the implementation of techniques used to overcome it.</p> <p>Also talk about whether this implementation is associated with a growth mindset and whether student benefitted from it.</p>	<p>Description of why it seemed hard to understand, and how they overcame this.</p> <p>Increased feelings of self-efficacy</p>

Selena

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<i>Selena: "Yeah so the reason why I started taking this course is actually because it is part of my prerequisite for my major animal science, um but I don't know I've grown to like it."</i>	Reason for taking course, school	"Can you tell me why you're taking this physics course and what this course means to you."	Response to challenge: Changed to like/love emotion
<i>Selena: "I tried in high school, but I totally like like I failed the class and had to drop out."</i>	Past context, school	"Have you ever been in a physics course before?"	Evidence for challenge, previously associated with physics
<i>Selena: "like in high school I got like a 2.1 GPA and like you know and in college, I got like a 3.7 or 3.5"</i>	Past vs. Present, school	"Have you ever been in a physics course before?"	Evidence for challenge, previously associated with school
<i>Selena: "I do believe that there's gifted people other than like the photogenic memories or is just really naturally just good at like math and like stuff like that."</i>	Description of gifted people that was touched on previously	"Can you tell me a little bit more about what you think about 'gifted people'?"	Nearby belief word: <i>naturally good</i>
<i>Selena: "I always had to like... you know tried to study more."</i>	Past context, noticing peers who were "naturally smarter" than her	"And was that throughout, like from elementary to college or was [ideas about gifted people] just something recent that you've started to notice?"	Nearby word for "unchangeable": <i>always</i>
<i>Selena: "When I was younger, I always felt like 'Oh shortcuts are the way to go. I can just like look it up on Chegg, you know, like that, write it down, and then now... it's a deep breath and then kind of like go through it again. Maybe I'll take like a you know snack break or something like that."</i>	Perseverance after evidence of challenge	"How do you push yourself to move forward with the challenge homework or do you just stop at that point and move on to something else?"	Response to challenge: Strategies – general – new/change
<i>Selena: "You know just keep on taking it one day at a time one step at a time even one hour at a time if needed."</i>	Explaining the difference between the effort she puts in now vs. in the past	"How do you push yourself to move forward with the challenge homework or do you just stop at that	Response to challenge: Effort – Hard work/significant time

		point and move on to something else?"	
<i>Selena: Everyone told me I was gonna fail it. I got an A last term, and I was like 'This is awesome. I love it,' and all my friends that are like smarter than me are like 'Omg you got an A,' like, 'I know right!'"</i>	Explanation of why physics is so enjoyable for her.	"Did you go into physics thinking the course would be that way?"	Response to challenge: Emotion - Like/Love (results based)
<i>Selena: "I found so much enjoyment in it. That's why I got an A and also because I needed for my GPA."</i>	Relates good grade to her enjoyment of the topic	"Were you surprised when you got a good grade?"	Response to challenge: Emotion – Like/love
<i>Selena: "Just to fly by get a C and then it would or B hopefully like you know for my GPA."</i>	Previous metric of success	"What was your mindset, what did you expect?"	Response to challenge: Emotion - Negative Future
<i>Selena: "An A. I know that they say it doesn't like you know after. Before I need exam or after any exam they're like oh it doesn't matter like you know you're still all important and that's great and all but my matter GPA does not think the same neither does that school, so you know I think an A."</i>	Current metric of success	"And this is kind of a broad question, but what does success in this course mean to you?"	Buzzword: Metric of success
<i>Selena: "I think that's the foundation of success right there is understanding is that way I can get that A."</i>	Grade is a metric of success and acknowledges that understanding plays a big role in it.	"And do you think you have achieved success and why or why not?"	Buzzword: Metric of success
<i>Selena: "Yes, you can understand it and not get that A, but at the same time, then I don't feel successful, so, if I understand the material and then get the A, then I feel successful, which is great, but yeah I just feel really defeated if I don't get a good grade on tests and stuff like that."</i>	Grade is a metric of success and acknowledges that understanding plays a big role in it.	"Do you think there's any discrepancy between your metrics of success versus understanding?"	Emotion: Discomfort – associated with not getting a good grade even if there is understanding

<i>Selena: "I think it just kind of changed it to kind of be like 'Oh you know, like, even if I do that on the test, I can still be successful.'"</i>	Response to challenge: Hard Work/Significant Time
---	--

Michaela

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<i>Michaela: "... I've never been as confident in math like all of my other classes so it was just kind of like math on steroids."</i>	Feelings before joining the course	"Before coming into this course, did you have any type of expectations about it? What were you feeling?"	Response to challenge: Negative smart label – "Never been as confident"
<i>Michaela: "I like when the equations work out. It's just intimidating when I look at them and then my mind just starts switching things around."</i>	Physics in high school was only offered through AP, and she didn't want to take it.	"What was the reason that you didn't take physics in high school?"	Emotion: Love/hate - enjoys the topic but challenges deter her
<i>Michaela: "... it is a love/hate relationship, because I like math and I like the study, but at the same time, it's just lots of equations."</i>	Emotions regarding physics	"You said that you didn't consider yourself a math person type of person. Could you delve more into that? And why do you think that?"	Emotion: Love/hate – enjoys the topic but challenges may deter her
<i>"I don't think I will ever develop a passion for it. It's not my type of side of science if that makes sense."</i>	Emotions regarding physics	"Why do you think you have not developed that passion for it. Do you have a reason for that?"	Emotion: Dislike – hasn't found the passion presumably because of the math heavy topic
<i>Michaela: "I would just leave questions blank sometimes if I wasn't confident in my answer, but with this class it's definitely taught me to like completely trust my process and, like write down even if it's not a valid answer."</i>	What has changed from other strategies that she has used previously to solve problems	"After taking about one term of physics, do you feel more confident in physics?"	Strategy: General – grading structure of the class allows for exercising a growth mindset
<i>Michaela: "This one's definitely coming a lot easier and I think it's because of those intro topics that we talked about in the first term."</i>	Attributing more confidence to this term	"Do you feel more capable at all between the two terms?"	Self-capability statements: Better/improvement

<p><i>Michaela: "I think the stuffs coming again easier this term, but I'm pretty satisfied with how it's played out. I'm grasping the concepts of this term better... I'm glad that I'm actually like learning stuff, so that's why I'm excited."</i></p>	<p>Attributing more confidence to this term</p>	<p>"Do you have more perceived satisfaction? And, did you think that between the two terms whether you achieved that success?"</p>	<p>Emotion: Positive future</p>
<p><i>Michaela: "Success in like any course is something I want to strive for just because I take pride in like what I do. But success in this course um what that means, to me, is it's kind of just completing it. That's going to be my ultimate success is getting through it and getting through it well. It might not be perfect. But in this... yeah."</i></p>	<p>Metric of success</p>	<p>"I want to ask you what does success in the course mean to you?"</p>	<p>Metric of success: Completion of course</p>
<p><i>Michaela: "So I guess success in this course would be completion with at least a B would be lovely... I'd probably cry if I got a C but I've gotten that before and I cried so that's fine um... Another point of success in this is that I want to be able to retain what I learned and like be able to take away stuff from this class."</i></p>	<p>Metric of success</p>	<p>"So your definition of success, would you consider it to be just completing the course or getting a certain grade, or the amount of effort that you put in, or what type? Could you delve a little bit more into it?"</p>	<p>Metric of success: Completion of course and Understanding/retaining materials – Emotions tied to how well course is completed as well</p>
<p><i>Michaela: "I felt all because I didn't know where to begin, so I was like "Oh my god, my entire career is going to fall apart." And then I felt kind of like not determined, but like kind of like, "Okay, well I'll show you," to my brain, and then I ended up working through it and</i></p>	<p>Facing a challenging problem</p>	<p>"Could you think of a time you had a particularly difficult challenge homework, could you describe how you felt in that situation?"</p>	<p>Emotion: Negative to positive future - achieved through hard work/significant time</p>

<i>it took me a while, but yeah."</i>			
<i>Michaela: "I guess it was a little bit of a shortcut. If I don't know where to start, I'm really hopeless so once they started that I guess it was kind of a shortcut, but I was able to finish the homework by myself, after that, so I mean there was some."</i>	Facing a challenging problem	"Do you gravitate towards finding a shortcut to finish the challenge homework, or do you think you took extra measures to try to understand?"	Effort: Giving up/stopping – Continuation of effort because shortcut is a starting point for learning
<i>Michaela: "I think I said earlier, but I kind of pride myself in what I do. Um and it's not so much like "Oh hey look at me. I'm a great academic." It's more like I just... I want to be able to learn, and I want to be able to accomplish things without the help of others, so I mean that's kind of mine."</i>	General metric of success in other courses	"Can I ask you why do you put effort into any other course?"	Metric of success: Doesn't want to just document results, but to also show understanding Different from what was stated as her definition for physics
<i>Michaela: "I think so. Um I definitely notice like I give more effort to some classes that I'm more passionate about than others."</i>	Is physics viewed differently from other courses due to passion	"You were talking about passion before, do you think that plays a big role in your level of effort?"	Theme – Passion or applicability may lead to less effort put forth
<i>Michaela: "I would say yeah. Yeah, I'll spend less time like learning it and more time like grasping it if that makes sense, like applying it. It's easier to build up that interest with those types of concepts."</i>	Response to challenge, gravitate towards or stray away from	"Let's pretend that it's a topic that you have a little bit easier understanding of. Would it change your interest level in the topic?"	Emotion: Lessening of discomfort – inflates decreased required level of effort to a greater sense of understanding

Susan

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<i>Susan: "I think, just like not seeing that like such a large impact on my grade from not doing well on exams"</i>	Anxiety reduced because she realizes exams do not affect her grades to the extent that she used to think	"Can you delve a little bit more into why you feel more confident going into the exams"	Emotion: Lessening of discomfort – Grade based

<p><i>definitely makes me feel better going into this term and kind of be like okay, 'Like I really struggled on the exams, but that wasn't the end all be all for my grade,' and so, like the anxiety has been toned down a little bit for exams for this term."</i></p>		<p>compared to last term?"</p>	
<p><i>Susan: "Oh yeah definitely um yeah like I've definitely referred to myself as not a physics person for sure. I've always struggled with like math and that's like mainly the thing is like I just struggle, a lot with math and physics feels just like applied math..."</i></p>	<p>History with math struggles translate into current physics struggles</p>	<p>"Have you ever heard of someone refer to themselves as a physics person?"</p>	<p>Self-capability statements – Negative label Buzzword: Nearby belief word - <i>always</i></p>
<p><i>Susan: "Like when I think of a physics person I think of somebody who is able to be like be like really quick on their feet with answering like questions about like math or like really wordy kind of problems that have a lot going on with them. Just in general, like somebody who's like obviously like super smart not that... like super smart, in the sense that they have like really strong book skills if that makes sense, like book smarts yeah."</i></p>	<p>Description of a physics person</p>	<p>"Okay yeah and what do you think a physics person is?"</p>	<p>Buzzword: Nearby belief word – <i>super smart</i></p>
<p><i>Susan: "I think the main thing that comes up for me is like just feeling overwhelmed by the course... but right now, it just feels like way too much to juggle and, and also, I feel, like some of the assignments, they put out like I feel like the</i></p>	<p>After listing feelings associated with the physics field in general, we started talking about what she feels about the course itself</p>	<p>"Okay, and you have any feelings about the course itself?"</p>	<p>Emotion: Discomfort</p>

<p><i>challenge homework assignments are honestly like too challenging like as somebody who is struggling in this class”</i></p>			
<p><i>Susan: “So I guess during like the challenge homework whenever I get stuck or something, I definitely get like... I feel really defeated.”</i></p>	<p>Emotions associated with challenges</p>	<p>“And you mentioned challenge homeworks and the difficulties that you've had with it. Can you describe how you felt in that situation and how did you go about dealing with that difficulty?”</p>	<p>Emotion: Discomfort</p>
<p><i>Susan: “When I can't do a problem by myself or can't even figure out how to get started by myself and so, most of the time, I really do just feel like I want to keep pushing off the challenge homeworks until the very last minute, because I'm very like avoidant. Like avoidant anxious, and so it like makes me want to push them aside and do them last minute which isn't a good idea.”</i></p>	<p>Discomfort can translate into avoidance or a lack of action</p>	<p>“And you mentioned challenge homeworks and the difficulties that you've had with it. Can you describe how you felt in that situation and how did you go about dealing with that difficulty?”</p>	<p>Effort: Avoidance</p>
<p><i>Susan: “I'll sit down with my partner and then him and I will go through it together kind of it, just like step by step so that I can get the assignment done on time and and he'll help me try and like understand some of the concepts and everything. Those are usually the steps that I take to like kind of work around the challenge homework and everything.”</i></p>	<p>Overcoming emotions of discomfort and avoidance</p>	<p>“And you mentioned challenge homeworks and the difficulties that you've had with it. Can you describe how you felt in that situation and how did you go about dealing with that difficulty?”</p>	<p>Strategy Use: Seeking out help (not peers)</p>
<p><i>Susan: “I want to be able to actually understand the topics that that we're discussing. I think, to me like that is the that's</i></p>	<p>Metrics of success</p>	<p>“Okay, and I want to ask you what does success in this course mean to you? So what are your definitions of success?”</p>	<p>Metrics of success: Understanding Contradictory from before where anxiety is lessened because exams</p>

<p><i>what like successes in physics right now it's just understanding the material than I feel successful and being sure that I am able to keep up with the course."</i></p>		<p>do not affect grades as much she thought</p>	
<p><i>Susan: "I wouldn't say that I have achieved success using that definition just because, like I mentioned, like, I am still really struggling with all the material that's presented in the class and having to like constantly get help to understand these concepts like with friends or through my partner through outside resources. Yeah I definitely don't think I would define myself as successful at the moment."</i></p>	<p>Using understanding as a metric of success, she doesn't think that she has achieved success</p>	<p>"Okay, and do you think you have achieved success, and can you delve a little bit more into why you think that?"</p>	<p>Perceived success: Negative</p>
<p><i>Susan: "...based off of last term I think I really do think that it did reflect pretty well like I got a B last term, and I was, and I was very, very happy with that actually. And I felt like I did put a lot of work into that class with whatever time that I had and so I was really happy about that, and I think that did kind of reflect the amount of effort that I put into it and because the grading is the same way, this term, I would say that, yes, I do feel that way."</i></p>	<p>Emotions are tied to the grades that she gets</p>	<p>"Regarding your grade, do you think that the amount of effort that you put in correlates with the grade that you get or do you think that there's a discrepancy there?"</p>	<p>Effort: Hard work/Significant time – believes it is reflected by her grades Emotion: Positive emotion</p>
<p><i>Susan: "Just because I felt like I was struggling with it kind of understanding how like these kinematics properties kind of relate to the field, I am</i></p>	<p>Interest in physics ties into her applicability of the topic</p>	<p>Okay, and why did you choose that number to describe interest?</p>	<p>Theme – Passion or applicability may lead to less interest and less perceived satisfaction</p>

<i>interested in going to, and so I just didn't feel that connected to that material."</i>			
<i>Susan: "I definitely agree that I would have rated it higher if I was more successful with understanding it yeah."</i>	Interest in physics ties into her success with the material	"Do you think if you had more success with the material, would you have rated it at a higher interest level?"	Theme – Success may lead to less interest and less perceived satisfaction
<i>Susan: "Yeah so I just think that, in general, like for me personally and my personality type like if I'm not good at something from the get go it kind of makes me not want to participate in whatever it is at all, and so that can be kind of frustrating whatever I'm like learning a new material that is harder and it just doesn't really make me enjoy the material because I don't think it's fun to have to struggle through a problem."</i>	Emotions tied to level of success achieved	"Do you think if you had more success with the material, would you have rated it at a higher interest level?"	Buzzword: Nearby word for "unchangeable" – <i>from the get go</i> Emotion: Dislike and Discomfort
<i>Susan: "I kind of just want to like coast through a problem rather than have to like go to several different people to try and get help on one problem for one assignment for one class when I have a bunch of other stuff going on."</i>	Emotions translate into avoidance response	"Do you think if you had more success with the material, would you have rated it at a higher interest level?"	Effort: Avoidance – Under context of dislike for challenges
<i>Susan: "Um I put effort into learning physics, because I really want to have a good grade at the end of the day. I wouldn't want my physics class to bump down my GPA at all..."</i>	Documenting outcomes/grades	"Why do you put effort into learning physics?"	Metric of success: Grades
<i>Susan: "...and there are some things that in physics, I do relate to my field so that's kind of the stuff that I really want to understand."</i>	Importance of passion or applicability	"Why do you put effort into learning physics?"	Metric of success: Understanding
<i>Susan: "I think, with the physics exams, sometimes I feel like</i>	Even though grades are fine, she feels the exams are too difficult because	Open discussion	Effort: Avoidance

<p><i>they're asking like too many like what I would call like an A level problem for like A students who know how to do everything and they don't really ask like kind of like C level questions. I guess for like a C level student who's like still like understanding the material and it's just struggling through it and I'm not sure if that makes sense, but I feel like asking too many like high level problems kind of puts other students at a disadvantage when maybe they shouldn't be."</i></p>	<p>she feel as if she doesn't understand much</p>
--	---

<p><i>Susan: "...like show what we know and everything without it being like a super complex problem that just kind of makes us like shut down a little bit when we're in an exam."</i></p>	<p>Response to feeling discomfort to challenging problems on exams</p>	<p>Open discussion</p>	<p>Effort: Giving up/Stopping</p>
--	--	------------------------	-----------------------------------

Wendy

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<p><i>Wendy: "... I will say that my expectations for physics before I even started were that it was going to be very hard and very time consuming because absolutely everybody that I've talked to has pretty much told me that..."</i></p>	<p>Previously took kinesiology class that contained physics but did not influence her expectations. Instead, expectations obtained from peers</p>	<p>"Do you think that has affected your expectations going into it, and can you kind of describe what your expectation was going into it and what it is now?"</p>	<p>Theme: Expects difficulty</p>
<p><i>Wendy: "Um, yeah um so I initially, for me, I was a little bit worried that it would be so hard, because it's just not something I'm super interested in. Like I'm</i></p>	<p>Difficulties associated with class includes feeling like concepts are not applicable to the future, applicability relates to her interest in the topic</p>	<p>"Okay, could you delve a little bit more into what is difficult about the class?"</p>	<p>Theme: Importance of applicability</p>

<p><i>totally fine with being challenged if I care about the work. Like I took Advanced Anatomy last year, and that was a lot of work, and it was hard, but I found it super interesting and so I'm glad I took it. But this,... I'm just kind of like don't see myself using any of the skills that I'm like learning in the future and it's just not super interesting to me, and so, initially, I was like worried that that would be the problem."</i></p>			
<p><i>Wendy: "... this class for me is difficult because I have a problem with how its structured. I am not a fan of the structure of the class. I'm not a fan of Professor Evan, just how he teaches is not for me and the amount of work that we're expected to do, I think is like borderline unreasonable."</i></p>	<p>Associates the structure and instructor as the biggest difficulties for the course</p>	<p>"Okay, could you delve a little bit more into what is difficult about the class?"</p>	<p>Emotion: Dislike – external factors</p>
<p><i>Wendy: "I'm a senior this year and I'm only taking this class and one other, and the amount of stress that I have felt from this workload has just taken such a toll on my mental health like more than any class I've ever taken and I... I cannot even fathom how there are people out there that are taking this, along with the full course load."</i></p>	<p>Describing why workload is unreasonable</p>	<p>"Okay, could you delve a little bit more into what is difficult about the class?"</p>	<p>Emotion: Discomfort</p>
<p><i>Wendy: "I'm a good student. My GPA is like 3.6, like I've taken really heavy course loads before so that's not this isn't like</i></p>	<p>Describing previous ability and success with taking difficult/heavy course loads</p>	<p>"Okay, could you delve a little bit more into what is difficult about the class?"</p>	<p>Self-Capability: Positive smart label – Attempting to reinforce ability to get good grades and be a good student</p>

<p><i>something I'm unfamiliar with..."</i></p>			
<p><i>Wendy: "...it's just if I felt like if this class had an aspect in it that was good, it's like, 'Okay well if I hate the material, at least the professor's good... or I hate the material and I don't like the Professor too much, but the structure is okay.' I'm not a fan of any of it personally. So that's really what's made it so difficult to stay motivated and try and not stress out."</i></p>	<p>Describing dislike of all aspects of the course</p>	<p>"Okay, could you delve a little bit more into what is difficult about the class?"</p>	<p>Emotion: Dislike/Hate</p>
<p><i>Wendy: "...if there were parts of physics that yeah, I felt were more interesting or like if you learn this now, this is going to be helpful later because you're going to be using it more like... Yeah, I would... I would take time to really learn and understand but it's just... it's a gen physics class so it's just such a broad overview of everything. Like I guarantee I'm not going to be thinking about angular acceleration once I'm done with this class."</i></p>	<p>Believes physics is not applicable as compared to other classes taken, applicability influences her interest</p>	<p>"You said that in an anatomy class you found the material more applicable to your future? So regarding that do you think that, if the topic was more applicable that you would have more of an interest or put more effort into learning the topic?"</p>	<p>Theme: Importance of applicability</p>
<p><i>Wendy: "I've taken statistics and that's whatever. Like I wasn't super interested, but I still managed to get like, I don't remember if it was an A or B. Like I've taken calculus. I've taken all sorts of classes and I guarantee I wasn't interested in all of it but I'm a good student. I like to do well in school, and so I can usually just kind of compartmentalize and</i></p>	<p>States that applicability influences her interest, but that doesn't usually deter her from getting a good grade</p>	<p>"Okay, and within that same topic, do you think if your success was related to... do you think that your success is related to your interest level, for you know certain topics?"</p>	<p>Self-capability: Positive smart label - Attempting to reinforce ability to get good grades and be a good student</p>

<p><i>just find a way to study, whatever that is. Get it done and just do what I need to do, but that's just been very hard in this class...</i></p>			
<p><i>Wendy: "Um I think my definition of success in this course specifically is different than in other courses because of how difficult this material is. For me, like I normally and like success means you know getting at least a B. I'm usually always A's and B's. I like to do well in school, but for this class specifically, I'm like the most reasonable thing for me means passing.</i></p>	<p>Has a different metric of success for physics class than other courses</p>	<p>"I also wanted to ask you what success in this course mean to you? Um yeah just your definitions of success."</p>	<p>Metric of Success: Completion/passing - Comparing to other classes, she doesn't feel capable in this course</p>
<p><i>Wendy: "I would say I was pretty proud of myself for doing a B last term that was great and so I think, in that sense, I achieved what my definition of success for this class is and I'm hoping I'm able to do it again for the next two terms."</i></p>	<p>Positive emotion linked to good grade</p>	<p>"...my other question was just whether you have achieved success and why you think so?"</p>	<p>Metric of success: Grades Emotion: Positive Emotion</p>
<p><i>Wendy: "I have a difficult time with most of the challenge homeworks and almost every time like I get very down on myself and I... I find that I just talk very poorly to myself, it makes me feel stupid."</i></p>	<p>Emotions experienced with challenging problems</p>	<p>"And I want you to think of a time that you had a really particularly difficult challenge homework, can you kind of describe how you felt in that situation?"</p>	<p>Self-capability: Negative smart label</p>
<p><i>Wendy: "I would say, like if I was having a very difficult challenge homework um then pretty much how it would go for me is it's just it's very frustrating I get very frustrated and it just makes me want to quit and just not even try and the most frustrating thing for me about the challenge</i></p>	<p>Emotions experienced with challenging problems</p>	<p>"And I want you to think of a time that you had a really particularly difficult challenge homework, can you kind of describe how you felt in that situation?"</p>	<p>Effort: Giving up/Stopping – Associated with discomfort emotion</p>

<p><i>homework is that I don't feel that I'm being adequately prepared to to complete them..."</i></p>			
<p><i>Wendy: "I reached out to my boyfriend, my friends who are better at physics, to help me out and I try and do my own research, but I just feel that I'm not being prepared enough to actually complete these literally on my own..."</i></p>	<p>Strategies to overcome challenging problems</p>	<p>"And I want you to think of a time that you had a really particularly difficult challenge homework, can you kind of describe how you felt in that situation?"</p>	<p>Strategy-use: Seeking out help and working with peers</p>
<p><i>Wendy: "I just wish that we were given at least similar... it doesn't have to be exactly step by step, what to do, but just given more similar problems to help work through, and so, if I'm not finding these things that I'm needing to complete my homework then yeah I will like take a shortcut and be like I know I'm doing this wrong, but I don't care anymore, just like be done with it."</i></p>	<p>Describing process of working through a challenge homework</p>	<p>"And to deal with the challenge homework after you've already given it a lot of effort, do you find yourself finding a shortcut to finish, or do you go ahead and take even more extra measures to try to understand?"</p>	<p>Effort: Giving up/Stopping</p>
<p><i>Wendy: "Like I don't have Chegg or anything like that, and I know that the professor's hate Chegg but I'm just like if all these students are needing to do the shortcuts or needing to use Chegg... if Chegg is such a big problem then maybe provide your students with sufficient lecture material and additional problems that we can like work off of because then we wouldn't have to use Chegg that much."</i></p>	<p>Describing process of working through a challenge homework</p>	<p>"And to deal with the challenge homework after you've already given it a lot of effort, do you find yourself finding a shortcut to finish, or do you go ahead and take even more extra measures to try to understand?"</p>	<p>Self-capability statements: Deflection</p>
<p><i>Wendy: "I'm more confident in that area now, so I feel like overall we're looking at my overall competence in my physics</i></p>	<p>Doesn't feel confident in physics knowledge, but slight improvement in some areas</p>	<p>"Okay, and you think after taking one term of physics so far you feel more confident in physics?"</p>	<p>Self-capability: Better/improvement - Doesn't view it positively because capabilities have not</p>

<p><i>capabilities right now, it's not fantastic in certain areas I have gotten better and I'm a little bit more confident but yeah. Overall, not not too much."</i></p>			<p>improved to the extent that she wants it to</p>
<p><i>Wendy: "I definitely don't identify as a physics person, and when I hear people say like I'm a physics person, I think that either means... I would say my boyfriend is a physics person. He literally loves physics, he loves talking about physics. He thinks it's very interesting and I just don't identify as that I would say...I just don't feel super confident like I couldn't hold a long conversation with somebody about physics concepts, I think that's probably like a defining characteristic of what I think a physics person is."</i></p>	<p>Description of a physics person</p>	<p>"Right and um have you ever heard of some people refer to themselves as like a physics person. What do you think that means and what do you identify as?"</p>	<p>Self-identification: Not a physics a person</p>
<p><i>Wendy: "I was over all of the constant quizzes all of the constant things I had to do and didn't have hardly enough time to breathe, and so my quote unquote learning method of last term was just click buttons until I get 100% and not even taken any information on the quizzes... Like I, I am not a don't try and just click buttons until you get the right answer, but it's just like what I felt like I had to do because I couldn't handle all of the constant things we had to do."</i></p>	<p>Method of learning for the first term</p>	<p>"Okay. All right, and do you think a method of learning has changed across the trends at all for this course?"</p>	<p>Effort: Giving up/Stopping</p>
<p><i>Wendy: "I really actually been trying to</i></p>	<p>Method of learning for the second term</p>	<p>"Okay. All right, and do you think a method</p>	<p>Strategy Use: New/Change</p>

<p><i>sit down and do the quizzes. Crazy right? Actually do the homework... I would say my learning method has changed from not trying at all to like trying to do the homework so maybe hopefully I won't have to cram quite as bad before the midterm."</i></p>	<p>of learning has changed across the trends at all for this course?"</p>		
<p><i>Wendy: "I put effort into learning for this course, because I need to pass in order to graduate, and I want to graduate like I want to get my degree. I'm in the homestretch and that's really the only thing that is motivating me, you know. I wish I found the material more interesting but um that's really it."</i></p>	<p>Effort for physics course</p>	<p>"...I know you have touched on this, but why do you think you put effort into learning for this course?"</p>	<p>Metric of success: Completion/Grade</p>
<p><i>Wendy: "I guess my hope is just that, I don't know, that maybe people like students in the future won't have to experience the amount of stress and academic burden that this course has caused me..."</i></p>	<p>Dislike for the course structure</p>	<p>Open discussion</p>	<p>Emotion: Discomfort</p>
<p><i>Wendy: "Well, maybe it's not best for me, maybe I want just a regular structured course. I want a regular lecture where you lecture because, when he stands there and lectures for five minutes and then he says, 'Okay talk to your neighbors and solve the problem.' I'm like I don't know how. I don't want to do that. I want you to walk me through how to do physics, instead of making me figure out absolutely everything."</i></p>	<p>Dislike for the course structure</p>	<p>Open discussion</p>	<p>Emotion: Dislike/Hate</p>

Alice

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<i>Alice: "I took O Chem last year. O Chem and physics are the two courses that everyone's like, 'Oh, these are really hard like you're going to hate them.' I loved O Chem. That was the best class I've ever taken in my entire life and I figured physics would be similar to where it'd be really challenging but it would be really fun. It's not really the case."</i>	Expectations going into challenging courses	"I took O Chem last year. O Chem and physics are the two courses that everyone's like "Oh, these are really hard like you're going to hate them." I loved O Chem. That was the best class I've ever taken in my entire life and I figured physics would be similar to where it'd be really challenging but it would be really fun. It's not really the case."	Emotion: Like/Love – Associated with challenges Emotion: Dislike/Hate – Associated with physics
<i>Alice: "I thought it would be fun. I thought it would be challenging and I think they're generally rewarding when they're harder so."</i>	Expectations going into course	"Yeah um did you have any feelings at all coming into the course? Like what type of feelings? Did you have expectations?"	Emotion: Like/Love – Associated with challenges
<i>Alice: "I went into like... I didn't want to just get the grade like I wanted to actually learn the material and so I've gotten all A's and all of my classes so far in my like college curriculum or whatever. "</i>	General background for her love of challenges	"...is this just something that you, you know, like recently discovered?"	Metric of success: Generally prioritizes understanding
<i>Cindy: "I like the challenge. I like actually mastering the subject I like going beyond what we're like taught in class like, especially since we're paying like a million dollars to go to the school like I'd like to get my money's worth and actually like fundamentally understand the material."</i>	Background for her love of challenges	"...do you find yourself enjoying more challenging courses like overall?"	Emotion: Like/Love – Associated with challenges
<i>Cindy: "No. This class has destroyed me it honestly. I walked out</i>	Describing lowered confidence in physics	"And after taking about like one term of physics already, do you think that you are more	Emotion: Discomfort emotion

<i>of the final and almost dropped out of school.”</i>		confident with physics?”	
<i>Cindy: “It was that bad because I spend 50 - 60 hours a week on physics, like, I spent an ungodly amount of time on it and I got to the final and I had like I sat down and I looked at the material and I genuinely thought I had walked into the wrong class.”</i>	Describing lowered confidence in physics	“And after taking about like one term of physics already, do you think that you are more confident with physics?”	Effort: Hard work/Significant time
<i>Cindy: “... it feels like there's no way to prepare and I like I don't know. I gave up after that. I went from like genuinely wanting to learn the material to deciding that like apparently that's not what we're doing in this course and we're just... I don't know what we're doing. Yeah I spend more and mornings crying and physics than anything else, so.”</i>	Describing lowered confidence in physics	“And after taking about like one term of physics already, do you think that you are more confident with physics?”	Effort: Giving up/Stopping – Given up on feeling like she understands the concepts, but has not given up on effort
<i>Cindy: “I've gotten A's. And that's fine and dandy but getting an A and learning material are two very different things and in every other course you take, you get an A when you learn the material, because the test represents your like fundamental knowledge of the material. I do not know in this course anymore...”</i>	Definition of success for this course	“All right, and I want to ask you what your definition of success in this course is?”	Metric of Success: Understanding
<i>Cindy: “I'm getting A's... I don't like... If you asked me to describe what I've learned so far, I could not coherently tell you things and it's the only class that I can't do that with so I don't know. I do not know if I have succeeded or not I</i>	Whether she has achieved definition of success	“All right, and I want to ask you what your definition of success in this course is?”	Metric of success: Understanding – Feels she has not achieved success, although on paper it may seem like it

<p><i>guess on paper... but I don't I don't feel like I am."</i></p>			
<p><i>Cindy: "It is so frustrating, I do not know what's real in this class. I do not know what's right in this class. It doesn't feel like there's ever a right answer."</i></p>	<p>Emotions attached to challenge homeworks</p>	<p>"And can you kind of think of a time you had a particularly difficult challenge homework? Maybe one where you put in a lot of effort and not so much progress that came out of it. Can you kind of describe how you felt in that situation?"</p>	<p>Emotion: Discomfort</p>
<p><i>Cindy: "It doesn't feel like there's ever a right answer. And we kind of just throw things out there and hope for the best, and I usually get 10s on my challenge homework like 10 out of 10 but I... there's been times like there was one with an ice cube and it said to melt the ice cube you take out heat, which, like I don't know what world we live in where like you like remove heat to melt things but I left that challenge homework like, I guess I don't understand the world in general and common sense doesn't count anymore."</i></p>	<p>Gets good marks on homework but doesn't think she understands the concepts</p>	<p>"And can you kind of think of a time you had a particularly difficult challenge homework? Maybe one where you put in a lot of effort and not so much progress that came out of it. Can you kind of describe how you felt in that situation?"</p>	<p>Metric of success: Understanding – Prioritizes understanding over grades</p>
<p><i>Cindy: "I don't know what I was supposed to get from that other than ice is different in the world of physics."</i></p>	<p>Gets good marks on homework but doesn't think she understands the concepts</p>	<p>"And can you kind of think of a time you had a particularly difficult challenge homework? Maybe one where you put in a lot of effort and not so much progress that came out of it. Can you kind of describe how you felt in that situation?"</p>	<p>Emotion: Negative future</p>
<p><i>Cindy: "More effort. Okay, I went from LAHHH hours to a second LAHHH hours to another person in class, to my... the LA who teaches my section</i></p>	<p>Proceeding forth beyond the discomfort emotions</p>	<p>"Did you... so basically what I'm trying to get at is like did you try to find a shortcut or did you go ahead and like put even more effort?"</p>	<p>Effort: Hard work/Significant time</p>

<p><i>and then to office hours to figure out why I ice melts differently in this course.”</i></p>			
<p><i>Cindy: “Okay so after the first quarter of physics, I knew I was going to have to spend an ungodly amount of time on this course so over winter break I watched all of the pre lecture videos for this upcoming quarter and took notes and so now that I’ve already watched them once before each week I watched them again and then there’s like all the hidden videos on Boxsand that maybe have the information you seek for the final. I don’t know so now I watch those and take notes on those and then I go to all the lectures. I don’t think KC or Evan likes me because I asked just so many questions in class and then, and then I do on the week before, I’ll do like Thursday night I do all my challenge homework and LAHHH. And then I’ll go to his office hours Monday and Tuesday to figure out or Monday Wednesday to figure out my challenge or my post lecture homework that I don’t understand. And then I go to Khan Academy online to figure out all of the things that I still don’t understand and then at a certain point, I give up and accept that what I don’t understand is just physics.”</i></p>	<p>Changing strategies from the first term to this term</p>	<p>“Go into detail about what your process is for learning.”</p>	<p>Strategies: New/Change Effort: Hard work/significant time</p>
<p><i>Cindy: “Defeat. I have adopted a lot of defeat.”</i></p>	<p>Feelings have changed from the beginning of</p>	<p>“... do you think your method has changed at</p>	<p>Emotion: Negative future</p>

<p><i>It doesn't feel like anything I do actually works. I had a less intense approach to last quarter and still didn't feel like I was learning, and then I did this this quarter and it still doesn't feel like I've figured out a way to be successful in this course. So I just keep trying new things, and it just eats up more and more of my time, but I don't think any of it is successful."</i></p>	<p>term, from enthusiasm to defeat</p>	<p>all across the terms or have you adapted anything?"</p>	
<p><i>Cindy: "One of my jobs is bartending and I've been really frustrated with physics and I found people who are good at physics and I trade them alcohol to teach me physics at work. This is a new technique. I never before had to do this, but that works well."</i></p>	<p>New strategies between the terms</p>	<p>"... do you think your method has changed at all across the terms or have you adapted anything?"</p>	<p>Strategy use: Seeking out help (not peers)</p>
<p><i>Cindy: "Because I like it, I genuinely like learning. I think knowledge is amazing, and that, like school, costs so much like why be here if you're not actually going to learn the material."</i></p>	<p>Effort for other courses and in general</p>	<p>"I want to ask you why you usually put effort into learning?"</p>	<p>Emotion: Like/love – Associated with learning and knowledge</p>
<p><i>Cindy: "Not a physics person at all...And that's just where you live. You accept that you're the dumb person because it's physics and everything's backwards and nothing counts and that's how it feels all the time. Like I walk in and feel more discouraged and dumber every day..."</i></p>	<p>Describing and negative identification with being a physics person</p>	<p>"Have you ever heard of someone like refer to themselves as a physics person or not physics person, why do you think they come to identify as that and like personally for you, what do you think you are?"</p>	<p>Self-capability: Negative smart label Identification: Not a physics person</p>
<p><i>Cindy: "I have not met one in the classroom yet who considers themselves a physics person. I looked so</i></p>	<p>Describing a physics person - Someone who is able to learn and comprehend the rules of physics, which she</p>	<p>"What do you think is the difference between someone within the classroom who considers herself like</p>	<p>Identification: Not a physics person</p>

<p><i>hard first quarter too because I was sure somebody had the secret of how to figure out this course and how to like learn but... I don't know. I don't know, I think the people that like in the bar that like understand and get physics have spent so much time with it at this point. Like they got their degree in it, so it wasn't just one course so they like learned all the rules that were not told."</i></p>	<p>may not have achieved because she has not spent required amount of time to reach that point</p>	<p>a physics person versus you?"</p>	
<p><i>Cindy: "I don't understand the point of writing a test, where the assumption is that, like the highest grade is going to be a 60% like what does that do other than discourage students and make them feel dumb."</i></p>	<p>Dislike for the exams</p>	<p>Open discussion</p>	<p>Self-capability: Negative smart label – Based on inability to answer questions on the exam</p>

Ben

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<p><i>Ben: "I took AP physics and I kind of struggled with AP physics. It was one of the harder courses I took. For some reason I just can't wrap my head around physics as well as other courses."</i></p>	<p>Took a previous physics class before</p>	<p>"...can you tell us whether you have taken a physics course beforehand and kind of what your expectations were going into this course?"</p>	<p>Evidence for Challenge: Activity Difficulties in the past Self-Capability: Negative label</p>
<p><i>Ben: "I guess somebody would identify themselves with a physics person if they're good at math and they do well during the physics exams but besides that, I really I don't really hear anyone say that they are a physics person. Okay, I would say I'm</i></p>	<p>Defining a physics person</p>	<p>"Okay and can you tell me a little bit more about why you were a little bit anxious about joining?"</p>	<p>Identification: Not a physics person</p>

<p><i>not a physics person, like I didn't do too well in high school but I'm still getting like Bs and stuff so it's not like I'm awful... I consider myself more chemistry oriented.</i></p>			
<p><i>Ben: "Physics is a lot more math, in my opinion than like then, like chemistry, I mean like there's math everywhere and I enjoyed learning about the physical world and physics like how everything interacts with each other. That's fun to me but uh besides that it's just like a lot of equations."</i></p>	<p>States that math is a deterrent for enjoying physics in the same way he enjoys chemistry</p>	<p>"Do you enjoy physics?"</p>	<p>Emotion: Love/hate relationship – Like concepts but requires use of math</p>
<p><i>Ben: "Um I did. Not so much anymore. Like I said, I'm not too well with Zoom."</i></p>	<p>Stated that he felt confident in the first term, but this term not as confident anymore</p>	<p>"After taking about like one and half terms of physics, so far, do you feel more comfortable or confident in physics?"</p>	<p>Self-Capability: Deflection - Zoom</p>
<p><i>Ben: "I would say success for this course would be memorizing the material, not just you know memorizing it for the exam and then forgetting it right after... like long term memorization of the material and then I guess doing... doing good and like getting good grades and stuff that as well. So both."</i></p>	<p>Definitions of success for the course</p>	<p>"What success in this course mean to you. So could you just give me your definition of success for this course?"</p>	<p>Metric of success: Understanding and grades</p>
<p><i>Ben: "I was kind of just annoyed at myself. Like I felt like I should have gotten the material. Like I should have done... I should have done... I should have had this easier."</i></p>	<p>Emotions associated with challenging problems</p>	<p>"Okay and let's think of a time you had a particularly difficult challenge homework, one where you put a lot of effort into it, but maybe you didn't make too much progress. Can you kind of describe how you felt in that situation?"</p>	<p>Self-Capability: Negative smart label</p>

<p><i>Ben: "Um I guess I keep working on it till... it's till it succeeded. I mean I don't I don't really know any other ways. Just keep working at it is what I've always been told."</i></p>	<p>Proceeding forth beyond the difficulty</p>	<p>"How do you go about dealing with that difficulty?"</p>	<p>Effort: Hard work/Significant time</p>
<p><i>Ben: "I'm definitely more of a shortcuts person because, like even for me shortcuts it's like yeah they could get you the answer, but then you go look at why that is the answer."</i></p>	<p>Utilizing shortcuts as a starting point for learning</p>	<p>"Would you consider yourself to kind of try to take shortcuts maybe or do you think you take extra measures like going to the wormhole going to, you know, talking to your study group, like what do you do at that point?"</p>	<p>Strategy use: General – Utilizing shortcuts</p>
<p><i>Ben: "The challenge homework, I say, is where I really start learning the material, because then I put it into practice a lot more than the other homework I was assigned, and so I say most of my learning starts at the challenge homework and then it goes back to it during review for an exam."</i></p>	<p>Challenge homeworks giving him the opportunity to learn through its difficulty</p>	<p>"Can you kind of describe your process for learning a new physics topic?"</p>	<p>Strategy Use: General – Embraces challenges</p>
<p><i>Ben: "I think I could put more effort into this class, but I put it towards other... other things, and I think I kind of get what I deserve."</i></p>	<p>Effort correlates with success in this course</p>	<p>"Do you think there's a discrepancy on the amount of effort that you put in and the outcome you get or your success?"</p>	<p>Self-capability: Meta-statement</p>
<p><i>Ben: "Um I put effort into learning because I want to know things. I guess for science like I... like I said before, I really like science, I just want to know about the world. How everything works. Besides that, I put effort in because I want to show grades. I want good grades, I want to be able to graduate with high standings."</i></p>	<p>States understanding and grades are reasons for putting effort into other courses</p>	<p>"Why do you put effort into learning in general?"</p>	<p>Metrics of success: Understanding and grades – Generally for other courses</p>

<p><i>Ben: "It is currently just for the grade. Just plain and simple. I didn't, I guess, I never really thought about it too much, but I put effort in physics, because it was on my planner and I already said that I wanted to do well grades wise."</i></p>	<p>States grades is the only metric of success for the physics course</p>	<p>"Yeah so within those categories that you kind of listed, why do you think you put effort into learning physics?"</p>	<p>Metrics of success: Grades – Physics course</p>
<p><i>Ben: "I would say I'd get less now, of course, only looking at the grade, and not actually thinking about, "Oh man, this is going to be real useful for me later."</i></p>	<p>Perceived satisfaction regarding having grades as a metric of success</p>	<p>"Considering that, um, do you think that has influenced your like perceived satisfaction in the course at all? Do you think you get more out of the course or less or it's kind of expected?"</p>	<p>Meta-Statement – Less perceived Satisfaction</p>
<p><i>Ben: "...I feel like it's based off the person. Like for me, if I didn't do as well, I'd just want to do better."</i></p>	<p>Interest level or applicability plays a role in level of effort</p>	<p>"Do you think if you didn't do as good would your interest level for the topic also go down as well? Or do you think that they're both kind of independent from each other?"</p>	<p>Effort: Hard work/Significant time</p>
<p><i>Ben: "I think I'd feel more dissuaded, but I'd want to do... I'd want to do better, but it would be like, 'Physics was not my thing, but I'm going to succeed in this course,' but I might not like to take other physics courses after is the issue with that."</i></p>	<p>Interest level or applicability plays a role in level of effort</p>	<p>"Do you think that would influence your interest in that topic?"</p>	<p>Effort: Hard work/Significant time – Only if course is required</p>
<p><i>Ben: "Okay, that threw me off so much and I guess I came to understand it more just from a lot of practice looking over those like sheets they give... just the equations.... trying to wrap my head around all the minor things."</i></p>	<p>Proceeding forth with rotational kinematics subject, which he states was a struggle</p>	<p>"Did you at all have an experience, where something seemed like really tough, almost impossible to understand, but you came to better understand it...?"</p>	<p>Effort: Hard work/Significant time</p>
<p><i>Ben: "Last exam was one of those sort of exams where it's like studying you forget like if you gave me that</i></p>	<p>Relating struggle back to his definition of success</p>	<p>"Do you think that helped you overcome that challenge?"</p>	<p>Meta-statement: Metric of success – Realize that he will not retain information on this topic</p>

<i>exam again right now I'd have probably a lot of trouble with that. I didn't really succeed in that."</i>	as he only studied for the exam
---	---------------------------------

Emily

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<i>Emily: "Yeah I feel like overall it's gone really well. The first time was definitely a lot more new stuff. This term I feel like we're doing a lot of the stuff we did in General Chemistry. But I definitely feel like the class is going well and it's not like crazy hard like everyone talked about."</i>	Expectations before coming into the course	"After taking physics for about one term, do you feel any more confident about physics, or being able to solve problems, tackle challenges?"	Emotion: Lessening of discomfort
<i>Emily: "I don't think I've heard someone say that they're a physics person. I do know people who like the class more than other classes. I think it's probably to do with the problem solving, finding the variables, going through the process, I guess... I don't think I'm so much of a physics person. I really like chemistry more and that kind of stuff and for me, I do like puzzle type stuff, but I'm just not so much a math person."</i>	Identifying a physics person	"And then, have you ever heard of someone refer to themselves as a physics person and why do you think someone would identify as that and what do you think you are?"	Identification: Not a physics person – related to math heavy course
<i>Emily: "Well, I think it kind of comes down to the specific type of chemistry, I really like kind of like what we're doing in organic chemistry right now. I like molecules and how they react, not so much the math which is what we're doing in physics."</i>	Identifying a physics person	"What do you think is the difference between a chemistry versus physics person?"	Identification: Not a physics person – related to math heavy course

<i>But I just I like interactions. I also like biology, like biological systems.”</i>			
<i>Emily: “To be honest, I am a pre-med student so A’s, just because you need to keep as high grades as possible, so an A is probably going to be success.”</i>	Definitions of success in this course	“And can I ask you what does success in this course mean to you? Like, what are your definitions?”	Metric of success: Grades
<i>Emily: “Since I’m not like going into a physics related field, I’m not worried about my long term retaining the information.”</i>	Definitions of success in this course	“And can I ask you what does success in this course mean to you? Like, what are your definitions?”	Theme: Importance of applicability
<i>Emily: “It kind of depends on the time I have. I will like... if I’m just needing to get everything in because I have like other classes that I have stuff for, I have a couple friends that I can reach out to be like, ‘Hey. Where do you go from here?’ Some friends like to send a picture of the work, others just tell me to use a certain equation, but I do always go back and work through it. If I have the time than I do like... I just keep going.”</i>	Proceeding forth with difficulty	“Yeah and how do you go about dealing with the difficulty? So what I’m kind of getting out of the question is, do you usually find a shortcut to do it, or do you take extra measures to figure it out?”	Effort: Giving up/stopping - Associated with no time
<i>Emily: “I have higher education goals. You have to do well on the MCAT and have good grades and stuff so I try to actually not just like skate through and try and succeed in school and stuff.”</i>	Reasons for putting effort into courses in general	“And can I ask you why do you usually put effort into learning?”	Metrics of success: Grades
<i>Emily: “Yeah there is a physics topic on the MCAT, so that’s part of and the other is just maintaining a high GPA.”</i>	Reasons for putting effort into physics	“Would you say that that is the same reason you put effort into learning physics topics as well?”	Metrics of success: Grades
<i>Emily: “I don’t have been any that were impossible to</i>	Proceeding forth through a difficulty	“In that unit, did you kind of have an experience, where	Effort: Hard work/Significant time

<i>understand, but there might have been ones that have taken longer to just remember what to look for. It just came down to repetition and like practicing other problems.”</i>		something seemed really tough, almost like impossible to understand, but you kind of got through that, and how you did you do that?”
--	--	--

Cindy

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<i>Cindy: “I’d say like it’s people that are really good at math because physics is like a lot of math and then it’s a lot of really good visualization of the problems at hand. I think, if you are really good to visualize and you’re good at math, you’re going to be good at physics.”</i>	Description of a physics person	“Okay, and have you ever heard of someone refer to themselves as a physics person and why do you think they identify that and what do you think you are?”	Identification: Physics person has to be good at math
<i>Cindy: “I think I’m more of a chemistry and bio person, but I’ve come to find out I’m actually kind of good at physics so I’m like okay.”</i>	Identification after describing a physics person	“Okay, and what do you think you are?”	Identification: Not a physics person Self-capability: Better/Improvement
<i>Cindy: “Definition of success... Um I would say A) being able to like understand, like understanding the material and then B) is like probably getting a grade B or higher.”</i>	Definition of success in physics	“Okay, and then, what is your definition of success in this course?”	Metrics of success: Understanding and grades
<i>Cindy: “I would say, probably understanding, strangely enough, because I’m like, ‘Oh, if I can like really explain it to other people...’ Like if I get to a B or if I get like an A, it’s not that much of a difference because if I can understand it, and like really prioritize</i>	Prioritizes one metric of success over another	“Yeah and you prioritize one definition over the other for this course?”	Metric of success: Prioritizes understanding

<p><i>understanding what I'm doing</i> so, just like memorizing everything then I'm ultimately going to do better. So for this course I'm like I'm trying to understand more versus like easier classes I'm just trying to get the A.”</p>			
<p>Cindy: “...if there's something that you just don't understand, then you struggle more with trying to understand then thinking it's cool because you don't know why it works. Then you're just like, 'I'm just confused why that's happening.' Yeah some people think things that they don't understand are cool. I understand that. I have a certain thing, but when it comes to physics like when I don't understand what's going on, it's harder for me to find it cool because I don't know what's going on.”</p>	<p>Success plays a role in interest</p>	<p>“Do you think your interest level would be affected by the success that you have on that topic?”</p>	<p>Emotion: Discomfort – Associated with challenges</p>
<p>Cindy: “The other ones were like you had to understand a lot of the conceptual stuff going on for it to make sense, because I was like, 'I just don't know where to start with.' It's like I know what I need to get. I don't know how to get there. So sometimes it took like me getting a hint of like, 'Oh you I use this equation and like this conceptual thing and they got together like this.’”</p>	<p>Proceeding forth through the difficulty</p>	<p>“Did you kind of find a shortcut to finish it or did you go ahead and take more extra measures?”</p>	<p>Strategy use: General – Utilizing shortcuts</p>
<p>Cindy: “I think some of them have helped me learn. Like just having to slog through a really complicated challenge homework like does</p>	<p>Challenge homeworks have the potential to be an opportunity to learn, but too many will have the opposite effect</p>	<p>Open discussion</p>	<p>Meta-Statement: Strategy use – sees importance of challenge, but affects time for other assignments</p>

help you out, but when you have two other ones, you have to do it's kind of like, it's either like you're going to spend all your time on the really hard one or you're just kind of like half ass the other two, you know. Because sometimes they'll be like, 'Oh yeah. We're just going to have you do super hard ones and you're going to have to do three of them.' Then sometimes like last week it was like one hard one and two easy one, so that one wasn't a huge deal."

Peter

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<i>Peter: "... if it was incorporated into a biology context, I would be more open to it."</i>	Was not "really into it" - Feelings associated with physics	"Okay yeah and physics in high school, how did you feel about it?"	Theme: Importance of applicability
<i>Peter: "I think it was just math heavy and it's just one of those stem fields that I'm not very interested in. I'm more interested in Bio."</i>	Was not "really into it" - Feelings associated with physics	"Okay yeah and physics in high school, how did you feel about it?"	Theme: Physics has intrinsic qualities that he doesn't gravitate towards
<i>Peter: "I don't really see myself much as a person who's very much into physics."</i>	Identification	"Have you ever heard of someone refer to themselves as a physics person or not physics person and you kind of talked about this a little bit, but do you, what do you identify as?"	Identification: Not a physics person
<i>Peter: "I think they're more interested in like just the mechanics of like how stuff works in a physical sense. Like I feel like they're more... I feel like they're less put off by the math and they just find certain</i>	Describing a physics person	"And why do you think that there are physics people and not yourself?"	Identification: Not a physics person

<p>parts of the subject more interesting.”</p>			
<p><i>Peter: “I feel like I’m less interested in just like thinking of how certain things are moving through space than how an animal like... how like the cell replicates. Right, I’m more interested in this biology.”</i></p>	<p>Describing a physics person</p>	<p>“So do you think a lot of it has to do with like you know, like the math part?”</p>	<p>Identification: Not a physics person – Boils down to interest in subject matter</p>
<p><i>Peter: “Possibly. But it’s hard to know but it’s most likely the case okay. But I can’t like say for certain, but I can say with educated guess, that’s the case... It much easier clicks and then with physics. It is harder for my connections to start.”</i></p>	<p>Describing whether success in topic correlates with interest level</p>	<p>“Do you think if your success was greater in that topic, do you think your interest level would also be placed at a higher number?”</p>	<p>Theme: Success correlates with interest level</p>
<p><i>Peter: “I feel like I do feel a little more confident in my physics, but I also don’t feel like I will pursue physics any further once the series is over.”</i></p>	<p>Describing confidence between the terms</p>	<p>“Yeah and after taking about like one and a half terms of physics, do you feel at all, more confident?”</p>	<p>Theme: Interest level is not correlated with confidence</p>
<p><i>Peter: “Like success in the course is actually leaving the course with understanding the material. Like leaving the course in knowing like how... knowing how like... with taking away like what was supposed to be taken away from the course. I feel like getting a good grade is a part of that, but I feel like it’s also important to actually understand.”</i></p>	<p>Definitions of success in this course</p>	<p>“I want to ask you what your definition of success is in the course. So what does it mean to you?”</p>	<p>Metrics of success: Understanding and grades</p>
<p><i>Peter: “I feel like in reality, understanding is much more important. But like what I do... but I do focus more on the grade because that like affects me now instead of like later down the road so it’s kind of being a little short</i></p>	<p>Prioritization of metrics of success</p>	<p>“What do you think is the most important because you did mention both understanding and grades. What do you think you prioritize more in terms of success?”</p>	<p>Metrics of success: Prioritizes grades</p>

<p><i>sighted but it's also like... because of just other things such as scholarships and stuff so like just mostly focusing on the grade..."</i></p>			
<p><i>Peter: "I do not think I achieved success because I often still struggle with a lot of the concepts and rely like heavily on those sheets that were allowed on the exam. I feel like if I just had to like glance at it, it would be okay, but I do have to like look at like the things that are done in the example problems to look for things and understand, instead of like feeling confident in my abilities and like have a solid understanding."</i></p>	<p>Achieved definition of success or not</p>	<p>"And do you think you have achieved success and why or why not?"</p>	<p>Metrics of success: Has not achieved</p>
<p><i>Peter: "What information they have does not stick after. They just have it during the course and as soon as they leave the course, they lose the information that they have."</i></p>	<p>Describing correlation between grades and understanding</p>	<p>"When you have a good understanding of a topic in the physics course that you have... that it shows in your grades basically? Or do you think it can be different?"</p>	<p>Meta-analysis: Getting a good grade does not mean that a person is capable</p>
<p><i>Peter: "I feel like I'm just studying it to get a good grade, even though I would like to be actually studying it to understand the material... that's like not the case, you know."</i></p>	<p>Prioritization of metrics of success</p>	<p>"Yeah and how do you view your understanding in this physics course. Do you think that the materials stick with you, or do you think you're just studying it so that you can get good grade?"</p>	<p>Meta-analysis: Acknowledges that he is focusing on grades, although he should be focusing on understanding</p>
<p><i>Peter: "I just finished the problem, but it didn't stick because I kind of just got so exhausted of trying and failing that like, once help came, I just took their help, but it didn't stick... just to get it done with it."</i></p>	<p>Proceeding forth with the difficulty</p>	<p>"All right, and then can you think of a time when you had a really difficult challenge homework and you put a lot of effort into it, but not so much progress came out of it. Can you describe how you felt in that situation?"</p>	<p>Effort: Giving up/stopping</p>

<p><i>Peter: "I feel like... I give up generally when I put in a lot of effort and it just ain't going nowhere. Then, like I just hit a point where it's like all right, like I just see the shortcut and then like that period can last for a bit of a while because I'm just drained."</i></p>	<p>Difference between times when he puts in effort and when he takes a shortcut</p>	<p>"And what are the differences between those times? Like when do you put in effort versus when do you kind of give up?"</p>	<p>Effort: Giving up/Stopping linked to feeling discomfort emotion</p>
<p><i>Peter: "I feel like I don't like actively go further than what is provided, which is maybe one of the reasons I don't fully understand. Like I don't go out of my way to find more resources to support."</i></p>	<p>Learning a topic</p>	<p>"Can you describe your process for learning a new physics topic?"</p>	<p>Meta-statement: Strategy use – acknowledges that he could put more effort into the class</p>
<p><i>Peter: "It's that 50% is a passing in the class. That is, I like it, because it makes it easier on me and it does make me feel like it does make it easier for me and it makes me less worried which alleviates a lot of things like test anxiety and things like that... but the issue for me is when I think about it, I feel like it's not the greatest thing to leave a course like only knowing 50% of the material essentially and so like I have mixed feelings about it... the base minimum of only leaving with 50% the material is not the best way of assessing how much students fully understand."</i></p>	<p>Problems with the grading of the exam</p>	<p>Open discussion</p>	<p>Theme: Inflating ability to answer question the exam as understanding</p>

Tom

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<i>Tom: "For like my degree, it's a hard science which can take an entire year, which is something very similar to like chemistry."</i>	Expectations before coming into the course	"Where did you get these expectations from? Was it from other friends, people who have taken the course before, or you know, your own experiences with physics?"	Evidence of challenge: Activity difficulty
<i>Tom: "...also something that is not going to be super applicable for me... so it was just going to be a grind... So I'm wanting to do physical therapy so pretty much everything after like the first two weeks of class I don't care about."</i>	Expectations before coming into the course	"Where did you get these expectations from? Was it from other friends, people who have taken the course before, or you know, your own experiences with physics?"	Theme: Importance of applicability
<i>Tom: "Probably around like also a four honestly because actually learning it was very boring, because it was just equation after equation after equation. But it is like one of the parts where it's... I can kind of get something out of it in a very big sense."</i>	Math heavy course	"Okay, and on a scale from zero to 10, with zero being that was really boring to 10 being that was the most interesting topic in class, where do you place your interest level for that topic?"	Emotion: Dislike
<i>Tom: "Yeah no it definitely does. Say, for the first two weeks, like I know I'm never gonna have to do those equations in my like field of work, to determine the amount of newtons and stuff like that's just not going to matter."</i>	Feelings associated with a math heavy course	"Yeah you did mention that you know, the first couple of topics, that you think that there might be some applicability to you know your future job. Do you think that at all has influenced your interest?"	Theme: Importance of Applicability – Negative future
<i>Tom: "Yeah cuz like I think physics concepts are really interesting to learn about, but I don't like... I don't care about the math of it because that's ultimately something I'll never have to do, and in my</i>	Previously stated that the class feels like a math class	"Okay, and do you think that um you know the math part of physics, do you think that has any influence on your interest at all?"	Theme: Importance of applicability – Contrast of emotions while learning concepts versus doing math

<p><i>head that's like the least fun part of physics, is getting calculations, as opposed to just learning like what this is and why it happens. I don't actually care about how many newton's it took to do something or anything along those lines."</i></p>	
<p><i>Tom: "I think a big part of it is their math capability like because one of my friends is taking this course and she's one of the smartest people I know, but she's not very good with like with numbers, like math calculations and stuff is not her strong suit. But she does really well with understanding all the concepts and she can like put stuff together really well."</i></p>	<p>Identification of a physics person</p> <p>"Do you know of anyone in general who does identify as a physics person?"</p> <p>Capability Statements: Contrast between positive and negative smart label</p>
<p><i>Tom: "... it kind of turned her off to the idea of like caring about physics, because it again, it just this has been a math class that we just use physics variables in and so that can be hard for a lot of people to find interest in. I think if you're not good at doing math, you don't enjoy doing it and then you wouldn't enjoy this class because that's that's it."</i></p>	<p>Identification of a physics person</p> <p>"Do you know of anyone in general who does identify as a physics person?"</p> <p>Emotion: Dislike/Hate – Associated with doing not doing well at a topic</p>
<p><i>Tom: "Yeah I would identify myself as a physics person. I enjoy it. That's one of the reasons I want to do kinesiology is because I really like the idea of like physics, for the human body, but yeah and I was actually thinking about being a</i></p>	<p>Personal Identification of a physics person</p> <p>"And what do you, what do you think of it yourself? Do you identify as one or another?"</p> <p>Identification: Physics person</p>

<i>physics major my freshman year.”</i>			
<i>Tom: “Just get through with the class with a grade that will help my GPA because I’m just taking this class for grad school applications.”</i>	Definitions of success for physics course	“Ok and what does success in this course mean to you? So basically, what are your definitions of success?”	Metrics of success: Grades
<i>Tom: “... for my classes that I’m taking that are kinesiology focused, I don’t really care as much about the grade, I just really want to understand the concepts, because I need to know what I’m doing if that’s going to be my profession. Okay, so it just kind of depends on the course.”</i>	Definitions of success for kinesiology classes	“Okay, and for those other courses, what do you consider your definition of success?”	Metrics of success: Understanding
<i>Tom: “...Yeah I think I have. For one, with physics, part of it is I want to get a good grade, but I also want to not put more effort into it than I think is really necessary because there’s so much work for this class and because I don’t really care about the class... I found a good way to like handle this class in a way that’s like good for me, and I can still get the outcome I want, and that also allows me to put more time and energy into the other courses that I care more about.”</i>	Whether he has achieved success based on his definitions	“And do you think that you have achieved success and why or why not?”	Metric of success: Grades while not putting in as much effort as necessary
<i>Tom: “It was so frustrating. Yeah it’s one of those things like when you put so much time into something, it sucks like when you turn in an end product that you’re still not proud of. So I think that was for me it was really frustrating and it took a lot, a lot of time, and I</i>	Emotions associated with challenge homeworks	“Okay, and can you think of a time when you had a really difficult challenge homework? One where you put maybe a lot of effort in and not so much progress out of it, can you kind of describe how you felt in that situation?”	Emotion: Discomfort

<p><i>just didn't really know where to go...</i></p>			
<p><i>Tom: "I definitely took a shortcut. I mean it's been a while, so I probably spent like two hours on that one specific one, and then it was like okay, "I'm done. This is good enough for partial credit. I'm showing you what I have." This term I have been going to LAHHH a little bit more. I've gone like two or three times. That's been helpful."</i></p>	<p>Proceeding forth after the challenge</p>	<p>"Yeah and explain to me how you went about dealing with that frustration? Like do you think you kind of took a shortcut to finish the challenge or do you think, you know, you put more effort, went to get help from the LAs, like what do you think you did?"</p>	<p>Effort: Giving up/Stopping</p>
<p><i>Tom: "Definitely just the required stuff... Yeah, for this course, I think, doing just the required stuff is good enough for me."</i></p>	<p>Studying for the course</p>	<p>"Okay, and would you kind of say that you know, you're just doing the required homework? Or do you think that you kind of put in more effort outside of what's required?"</p>	<p>Effort: Giving up/Stopping</p>
<p><i>Tom: "In general... Well, I for one just really like learning in general, more important than even the topics themselves. I think it's really cool to see the way that different things happen in different processes in different fields. Yeah so that's part of it, and then, I think that works for me with the first few weeks of every term but then you kind of get burnt out and sadly not care anymore about the learning part and so I learned partly to be successful in my career in the future because that's like the reason I'm at college and then the second part is learning because I'm required to."</i></p>	<p>Difference in how beginning of them term vs the</p>	<p>"Yeah and why do you think that you put effort into learning in general?"</p>	<p>Effort: Giving up/Stopping - Associated with burnout</p>

Paul

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<i>Paul: "My definition's about getting an A in the class. I have a high GPA. I'm trying to go to medical school so my grade is definitely important to me. It's also important that I get something out of it."</i>	Definitions of success	"I want to ask you what your definition for the class is? Do you have multiple? Do you have just one primary one?"	Metrics of success: Grades and understanding
<i>Paul: "It's kind of hard to say. Some of them feel more intuitive than others. When you think of kinematics, most of it is linear versus with rotational, it's a little bit harder to figure out sometimes. It just doesn't feel intuitive."</i>	Retention of topics	"Do you know why for some topics you have more retention of the topics?"	Intuitive topics leads to greater retention of topics
<i>Paul: "Recently, I think it was the last challenge homework, it was about an adiabatic process. I got through 3 or 4 out of the 5 total questions, and the last 2 I was completely lost. I felt frustrated. I spent 3 hours on it. I felt like I was slamming my head into a wall. So I texted a few friends in the class and I got a few pointers. But the last one was an open ended question that was more reasoning. I didn't feel great about it. I didn't feel confident in it.."</i>	Emotions associated with challenge homework	"And I want you to think of a time where you had a particularly difficult time on a challenge homework? Maybe when we put in a lot of effort, but not a lot of progress came out of that. How would you describe your felt in that situation?"	Emotion: Discomfort
<i>Paul: "I think there's a cutoff threshold. Once I get a few hours into it, I can get really frustrated and I don't feel like putting more effort in. Sometimes, if I have enough time in</i>	Proceeding forth with a difficulty	"And would you say that you generally tend to try to find shortcuts to finish it when you're at that point or you usually put in more effort and more time?"	Effort: Giving up/Stopping

<p><i>advance, which is rare, I'll put it aside and sit on it for a bit. But if I get close to the deadline, I'll google search. See what I can get."</i></p>			
<p><i>Paul: "Because it's more self-guided, I definitely had to adapt to starting my week off a little more productive and setting up time for myself to prepare at the beginning of the week. I feel like a lot of students, and I'm guilty as well, just don't watch anything, and come into class lost. That's a common experience I feel. If you're the one person who actually watches the material, you can often times help other people."</i></p>	<p>The first term, realized course is more self-guided than expected</p>	<p>"And do you think that you change your method of learning at all between the terms or have you adapted anything?"</p>	<p>Strategy Use: New/Change</p>
<p><i>Paul: "I am definitely not a physics person. I can definitely tell you that. Physics is my worst subject."</i></p>	<p>Identification of a physics person</p>	<p>"Have you ever heard of someone refer to themselves as a physics person? Why do you think someone would say that, and what, what do you identify with?"</p>	<p>Identification: Not a physics person</p>
<p><i>Paul: "I think a physics person is very similar to an engineering mind, where they can take physical problems and turn it into a math problem or break it down which architects engineers are really good. So being able to turn real life applications into math problems step by step."</i></p>	<p>Identification of a physics person</p>	<p>"Have you ever heard of someone refer to themselves as a physics person? Why do you think someone would say that, and what, what do you identify with?"</p>	<p>Identification: Physics person related to math capabilities</p>
<p><i>Everybody has a strong suit. Some people are better at certain areas. I definitely think that with physics it definitely takes a</i></p>	<p>Identification of a physics person</p>	<p>"Why do you think you're not such a physics person?"</p>	<p>Self-capability statement: Negative smart label and Better/improvement</p>

<p><i>strong math background which I didn't always have. I definitely got better over time. But I've noticed some people are really good at... I have a couple of students in the class that I sit with that are able to pick apart a problem right away, so I think a lot of it has to do with that ability to pick apart a problem and critically think through it."</i></p>			
<p><i>Paul: "Kind of a balance, I feel like if you're completely lost and you don't know how to approach it, you might not enjoy it as much versus where I really enjoy a topic, maybe I know most of it but lacking a few pieces, which then makes it more interesting. But then there's also a case of where it feels extremely obvious, So it has to be the middle piece, where you have a good base knowledge, you know where to start with questions but there's a few pieces that you can work on."</i></p>	<p>Factors that influence interest level</p>	<p>"You said that you understood kinematics, do you think your success correlates with your interest level or understanding at all?"</p>	<p>Theme: Interest level correlates with the success achieved</p>
<p><i>Paul: "A) To get good grades. B) I'm trying to get to med school. C) I want to get something out of it. I want to understand whatever I'm learning."</i></p>	<p>Reasons for putting effort into any general course</p>	<p>"Why do you put effort into learning?"</p>	<p>Metric of success: Grades and understanding</p>
<p><i>Paul: "For me, a lot of it has to do with my grade. I don't think physics is my topic of interest, so I don't put the same amount of effort as other topics,</i></p>	<p>Reasons for putting effort into physics</p>	<p>"And regarding physics with that context, why do you like put so much effort into learning physics?"</p>	<p>Buzzword: Nearby intrinsic word</p>

but having said that I still want physics because B) It's not my topic so if I put effort it into it, so if I can get better at it, then I can get a better grade. Getting a better grade in a topic that I was not naturally gifted at is good."

Rob

<i>Student Statement</i>	<i>Story Context</i>	<i>Interviewer Question Context</i>	<i>Mindset Coding</i>
<i>Rob: "Expected difficulty. I suppose it's been... it's one of the courses that people talk about around campuses being one of the more challenging... I would say expectations are accurate."</i>	Expectations before coming into the course	"Okay and what were your expectations going into this one besides the fact that you stated that your high school course didn't really change any expectations for you?"	Evidence for challenge
<i>Rob: "...not exactly sure where to start on that so I'm going to go do the pre lecture and then hopefully pick up the tools on that to address that problem but whereas general applicability to all of physics, the problem solving strategies aren't as important as the exact tools, equations, knowledge of relationships, etc."</i>	States that he feel confident in physics this term, as a result of knowing how to approach problems	"And do you think after taking about, you know, one and a half terms of physics, do you think you're at all, more confident with being able to solve the problems or issues?"	Strategy use: Strategies – General
<i>Rob: "But it doesn't frustrate me so much as it's like it's an itch you gotta scratch."</i>	Emotions associated with challenge homeworks	"Regarding trying that challenge homework, since you brought that up, um can you think of a time where you had a particularly difficult one, maybe one that you put effort in but maybe not too much progress. Can you kind of describe how you felt in that situation?"	Emotion: Neutral

<i>Rob: "I put more effort in. I have not taken a shortcut for challenging work, other than like, I guess if you consider getting direction for problem solving from the LAHHH."</i>	Proceeding forth with a difficulty	"...do you take shortcuts or do you put more effort in?"	Effort: Hard work/Significant time
<i>Rob: "It's something I've done for a long while. It also relates to having a I guess what they call that positive growth mindset."</i>	Proceeding forth with a difficulty	"Yeah and so um, can you tell me why you're able to just put even more effort in? How does this relate to your mindset? Is it something that you've always done?"	Identification: Growth mindset
<i>Rob: "Well if you don't put the work in to tackle difficult concepts, then you'll never learn. It's like trying to lift weights, but you don't... you're trying to get stronger, but you don't want to go to the gym and lift weights. Yes, it requires effort and struggle to become better at anything in life."</i>	Mindset leading to associated actions	"And do you think that at all changes your success in the course? If you identify with that mindset, do you think that changes your success at all?"	Effort: Hard work/Significant time
<i>Rob: "Definition of success for this course would be the passing grade and a basic understanding of the principles of physics."</i>	Definitions of success for the physics course	"Okay, and I want to ask you what your definitions of success are in this course?"	Metrics of success: Understanding and grades
<i>Rob: "I think they should go hand in hand, but that may not always be the case... Yeah a great passing grade more than, unfortunately to say, but that's the nature of the beast despite what Dr. Thatcher said in class about you know understanding is more important, the way the system is constructed... um that can't be the case."</i>	Prioritizes one metric over the other	"Okay, do you value one over the other? Or do you think they go hand in hand?"	Metrics of success: Prioritize grades
<i>Rob: "I would describe my understanding as fundamental, still, at a</i>	Believes he has achieved success in	"Yeah like what do you think your understanding in	Self-capability statement: Better/Improvement

<i>base level but a lot further along than when I started.”</i>	both his measures of success	physics is currently at?”	
<i>Rob: “Oh yeah, I feel like I have made great progress and understanding of the relationships and how the world around works, you know, on a fundamental level... It's been a thing in development since day one. Another brick in the wall every lesson plan we go through.”</i>	Describing fundamental understanding of physics	“Yeah like what do you think your understanding in physics is currently at?”	Self- capability statement: Better/Improvement
<i>Rob: “I'm an older student so I don't have to be here and I'm not just here for the degree, but since I'm getting one, I wanted to retain as much as possible from the process.”</i>	Effort in learning	“In general, why do you put effort into learning?”	Metrics of success: Understanding
<i>Rob: “It seems like you meet a lot of people in the world who have degrees, even graduate degrees and seem to not even have a basic understanding of their field and I'm kind of disgusted by that.”</i>	Effort in learning	“In general, why do you put effort into learning?”	Emotion: Dislike/Hate
<i>Rob: “I want our educational system to be more than something you feed money and time into for a piece of paper. I feel we should actually learn and get better and have understanding, because when you know somebody gets more educated it benefits the self.”</i>	Effort in learning	“In general, why do you put effort into learning?”	Meta-Statement: Importance of effort
<i>Rob: “Yes physics is challenging, and for the most part, I enjoy the challenge when it's not like I guess a midterm, like a do or die kind of thing. Challenge homeworks I like.”</i>	Emotions associated with challenge	“Do you think that physics is challenging and yeah do you think that you enjoy that challenge, or do you kind of shy away from it?”	Emotion: Like/Love

