Metacognition and Motivation in Anatomy and Physiology Students

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The purpose of this study was to use a grounded theory, qualitative approach to gain a deeper understanding of students' self-regulated learning processes in a required first-year gateway Anatomy and Physiology (A&P) course that is critical for success in health care-related academic programs and professions. At the end of a two-semester sequence in A&P, students were recruited to participate in individual 30-minute semi-structured interviews based on questions related to their metacognitive beliefs and behaviors. Investigators reviewed verbatim transcripts from 25 primarily first-year students and identified four major themes: 1) career orientation, 2) relevance of Anatomy and Physiology, 3) success as the ability to earn good grades, as well as retention and ability to apply materials, and 4) student behaviors referring to the learning and metacognitive strategies reported by students. Within the theme of student behaviors, four sub-themes emerged: collaborative work with peers, self-responsibility, self-awareness, and evolution as learners. The results of this study will help investigators to design and implement strategies to improve success in this course for pre-health professional students.

The ability to regulate and monitor the quality of one's own learning process is an essential skill for individuals across a range of contexts. While cognitive monitoring and metacognition have long-been considered crucial elements of learning (Flavell, 1979), there is also a recognition that the capability to self-regulate learning is becoming more and more important because of structural changes in society (Bjork, Dunlosky, & Kornell, 2013). In the 1970s, John Flavell (1979) presented a model of cognitive monitoring that consisted of a set of interconnected factors including metacognitive knowledge, metacognitive experiences, actions (or strategies), and goals (or learning tasks). Metacognitive knowledge includes both a comprehension of cognition in general, as well as self-referential knowledge about one's own goals, actions, and beliefs regarding the process of cognition. Metacognitive experiences encompass both emotional and cognitive states. For example, judgments about whether something has been understood correctly or incorrectly fall under the construct of metacognitive experiences, but this construct also includes the affective consequences that arise in the process of cognitive acts (Flavell, 1979). Particularly when confronted with new and challenging tasks, these metacognitive processes involve the regulation of both emotional and cognitive resources (Ambrose, Bridges, DiPietro, Lovett, & Norman, 2010).

In the past few decades, researchers have expanded and examined the socio-cognitive system of self-managed learning. Self-Regulated Learning (SRL) is a model which describes "the degree to which students are metacognitively, motivationally, and behaviorally active participants in their own learning processes" (Zimmerman, 2013, p. 137). SRL is comprised of a group of learning-related strategies, including an ability to evaluate one's performance, seek out necessary information and other social supports, set up a reasonable learning environment, and maintain productive studying practices (Zimmerman, 2013). Within this model, the process of self-regulation encompasses three phases. In the first phase, forethought and planning, learners set out goals and plans and consider their beliefs about their ability to learn the material as well as the value of the task itself. In the second, performance monitoring phase of the cyclical self-regulation model, individuals must observe and monitor their attention, cognitions, and performance in learning-related tasks. Moreover, they must control their environment, behaviors, and cognitions to meet the task-related requirements. The third phase of the process involves self-reflection, during which individuals reflect on whether they achieved their desired outcomes, as well as how and why these goals were or were not achieved. During this phase, individuals must also manage their cognitive and emotional reactions accordingly (Wigfield, Klauda, & Cambria, 2011; Zimmerman, 2013).

Self-regulation theories generally account for how humans adapt to environments (Zimmerman & Cleary, 2009), and in order to effectively pursue goals, individuals must often regulate their behaviors, cognitions, and emotions (Karoly, 1993; Sitzman & Ely, 2011). Indeed, students who show higher levels of self-regulatory practices perform better academically, as measured by both their grade point averages and standardized test scores (Zimmerman, & Kitsantas, 2014). Ultimately, SRL is a cyclical process in which effective learners engage in the forethought phase, followed by the performance phase and then the self-reflection phase, during which they make judgments and adjustments as necessary. These cyclical processes are, therefore, feedback loops in which self-regulated learners alter their actions

depending on the consequences of their behaviors (Zimmerman & Cleary, 2009).

SRL models traditionally suggest that intrapersonal processes of self-regulation are embedded within a person, who is also embedded within a larger environment. Individual motivations and other person-level variables can, therefore, affect the cognitive and metacognitive strategies which students employ (Efklides, 2011). One of the most salient of these individual differences is learners' estimation of the value of the task. Students' perceptions of the relevance of coursework varies, but it generally seems to fall into two broad categories: those that they consider directly relevant and those that they consider to be indirectly relevant to their personal, academic, and occupational development (Pisarik & Whelchel, 2018). Those students who place a higher value on the material they are learning tend to be more persistent in their work and utilize more cognitive and self-regulatory strategies (Pintrich & DeGroot, 1990). An important component of this value emerges from the larger reasons students have for pursuing their educational goals. These goals help motivate them and are influenced by both personal and contextual factors (Berkhout, et al., 2015). Even when lessons have been intentionally drained of all engaging content that might serve to trigger positive affect toward a subject, providing a reasonable rationale for learning the material can promote engagement, regulation, and better conceptual understanding (Jang, 2008). More proximal goals are other person-level factors that are also important in learning. In a meta-analysis examining which aspects of self-regulation were associated with learning in work-related education and training, self-set goal levels for performance standards emerged as one of the strongest predictors (Sitzmann & Ely, 2011).

Students' mindsets about the nature of intelligence, their perceived ability to learn material, and their sense of responsibility for learning are other person-level variables that work in conjunction with more fundamental metacognitive processes to determine the manner in which they approach studying and their performance in school (Ambrose, et al., 2010; Zimmerman & Kitsantas, 2005). While some individuals conceptualize intelligence as fixed, others have a more incremental view and believe that experience or effort can change one's intelligence. When students believe that their intelligence is immutable, they tend to be more focused on "performance goals" or goals that can demonstrate their overall ability. When students hold a more incremental or "growth" mindset, they are more likely to have "mastery" goals and thus are more likely to persist when tasks are difficult or when they initially experience failure (Blackwell, Trzesniewski & Dweck, 2007; Elliott, & Dweck, 1988). Students also differ in their overall sense of efficaciousness for learning and their engagement in school (Fredricks, Blumenfeld, &

Paris, 2004; Pintrich & Degroot, 1990). Students' ratings of self-efficacy for learning are also associated with their perceptions of who is responsible for the learning process: their teachers or themselves. For example, among a sample of high school girls, the quality of their homework assignments was associated with their GPAs, as mediated by their perceived self-efficacy for learning and perceived responsibility for learning (Zimmerman & Kitsantas, 2005).

There is an ever-more intense focus on understanding and supporting students' self-regulatory and metacognitive practices because of a growing recognition that it is important to help them learn to reflect critically, to develop an understanding of their discipline, and to think like scientists or professionals in the field (Metzger, Smith, Brown, & Soneral, 2018; Sandars & Cleary, 2011; Tanner, 2012). Changes in the structures of our society and the demands of many jobs are prompting a need for individuals to initiate and manage their own learning more effectively across the span of adulthood (Bjork, et al., 2013; Zimmerman, 2002). Learning to self-regulate the process by which one learns has, therefore, become a particularly important skill because most adults must engage in a life-long learning process across a variety of professions and contexts (Sitzmann & Ely, 2011; Zimmerman, 2002). This is perhaps particularly important in the field of health care, because advances in biomedical techniques and technology require practitioners to update their understanding of the field regularly, making the ability to self-direct their own learning an essential skill. Moreover, those who enter particular professions where they must conceptualize a specific case, make decisions, and act accordingly need to hone metacognitive skills because, without an awareness of the metacognitive process, errors in critical thinking may to lead to dire consequences (Medina, Castleberry, & Persky, 2017).

Though there is broad agreement that SRL represents an important theory in the field of education, there are still many unanswered questions about the relevance of each component of the process and the ways in which personal characteristics interact with specific features of the situational task to produce learning outcomes. This is particularly true for our understanding of SRL processes among higher education students (Schober, et al., 2015). In their meta-analysis examining self-regulated learning in programs for work-related training, Sitzmann and Ely (2011) suggest that more qualitative research examining the ways in which students engage in self-regulatory processes across the course of a semester within a particular context could help elucidate the overall process and better-identify possible interventions to support the self-regulatory processes (Sitzmann & Ely, 2011) and thus academic success.

Table 1
Participant Characteristics

Characteristic	M	(SD)
GPA	3.41/4.00	(0.5)
A & P I Grade	83.8	(7.8)
A & P II Grade	90.5	(7.8)

	n	Percentage
Gender (N = 25)		
Female	18	72
Male	7	28
Year in School (N = 25)		
Freshman	21	84
Sophomore	3	12
Senior	1	4
A&P I Grades (N = 25)		
A or B	19	76
C	5	20
D	1	4
A&P II Grades (N = 24)		
A or B	21	88
C	3	12
D	0	0

Note. N = 25

Therefore, the purpose of this study was to use a grounded-theory, qualitative approach to gain a deeper understanding of students' SRL processes in a first year Anatomy and Physiology course sequence that is critical for success in students' academic programs and their future professions. Anatomy and Physiology I and II are required courses and are important first year gateway courses for the health professions. Students can often struggle with the large volume of highly detailed material. Success in this course is critical for progression through health professions programs. In order to be successful in clinical health care, practitioners need to develop metacognitive habits of mind and critical thinking abilities. An understanding of these processes in beginning undergraduates may help to develop these abilities for the future.

Method

A qualitative research design was implemented in order to examine how students approached the Anatomy and Physiology courses, the motivation for studying in these courses, and the ways in which they regulated their learning during the semester. An exploratory approach, based on grounded theory methodology and principles, was utilized to provide the researchers with the opportunity to gain a deeper understanding of the perceptions and needs of a particular group, in this case, students (Creswell 1998;

Foley & Timonen, 2015; Levitt, Motulsky, Wertz, Morrow, & Ponterotto, 2017; Strauss & Corbin, 1990).

Participants

This study was conducted at a private comprehensive residential college with 3500 full time undergraduates and 575 graduate students representing 32 states and 31 countries. The population is about 50% male and 50% female and of traditional college age. The Department enrolls 419 majors, (25% Athletic Training, 45% Exercise Science, 30% Health Sciences). Data presented in this study was collected at the end of the Spring 2017 semester at the conclusion of completion of a year-long Anatomy and Physiology (AP I & AP II) course sequence. All students in the courses were invited to participate in the study, and they received extra credit for their participation. Any students interested in the study informed researchers and enrolled in the study. All participants consented to participate in this research in accordance with the College's IRB protocol, resulting in twenty-seven participants. One student did not complete the interview, and one interview was lost to technical difficulties (see Table 1 for a description of participants' characteristics), leaving 25 interviews to be transcribed. One interviewee did not obtain the required C or better grade in A&P I and so was not able to move on to the second half of the course.

Materials and Procedure

We used purposive sampling to recruit students for the study. Upon enrollment the participants were interviewed in person for 20 to 30 minutes by two authors. Prior to their interview, each participant chose a pseudonym. Only those pseudonyms were attached to the recording tapes, transcriptions, coding, and results presentation.

Both researchers performed informal, ongoing data analysis during interviews. After initial interviews were completed, the researchers met and agreed that data saturation was achieved, so no further participants were recruited. Interviews were conducted independently by two researchers, not associated with the A&P course sequence, who were involved in the design of the semi-structured interview guide which was created for the purposes of this study (see Appendix). The semi-structured format was utilized because the researchers wanted to maintain consistency throughout the interviews to enhance the integrity of the data without losing the opportunity to follow up with questions and delve more deeply into responses when needed. The interview methodology allowed researchers to gain an in-depth understanding of students' perceptions of how they learn and their understandings of their metacognitive behaviors. The semi-structured format provided flexibility for the researchers to be able to probe more deeply into participant responses and to ask follow-up questions leading to richer, more robust data. Interviews were recorded and transcribed verbatim.

Data Analysis

According to Strauss (1987), grounded theory analysis is an approach in exploring the data when the researcher does not have any prior assumptions regarding the research topic since data are not collected prior to any former conclusion. As a result, there is a possibility of theory formation (Strauss & Corbin, 1998) out of the gathered data. In alignment with this theory, the two researchers who conducted the interviews independently analyzed the data from all of the interviews, using constant comparative methods through the following process: 1) identified codes and created categories (open coding), 2) reread the data to determine themes and subcategories (axial coding), and 3) determined the main themes and supporting data (selective coding (Glaser, 1965; Strauss & Corbin, 1990). A post-positivist orientation was utilized as the researchers strove to objectively analyze the data so that the participants' perspectives were accurately represented (Levers, 2013). Independent analysis by two of the researchers supported this approach and increased the likelihood of objectivity. After analysis, the researchers compared and agreed upon themes and subthemes that emerged from the data. The third and fourth authors then reviewed and confirmed the findings.

Data Credibility

According to Creswell (1998), at least two strategies should be implemented in order to ensure credibility of the data. We implemented peer reviews and multiple analyst triangulation as described above. We also included data triangulation through the use of field notes taken during the interviews. These were used to confirm themes during data analysis.

Results

Interview Themes and Sub-Themes

The theory that emerged from analysis, shown in Figure 1, is that in A&P, student learning and metacognitive behaviors are influenced by career orientation, relevance of the course to career goals, and students' definition of academic success. In-depth descriptions of themes and sub-themes are presented below.

Career Orientation

Participants in this study all expressed that attending college and then entering a profession after graduation was their predetermined pathway after high school. They expressed that it was simply what everyone did and what was expected of them. For example, Ellen said, "It was just something that was expected from my parents. They both went to college, and my mom has her Master's…" Some were motivated by the fact that one or both of their parents either did not attend or did not complete a college degree and that they could thus be the first to achieve a goal that was important to the family. Grace stated, "I'm the first one in my family to go to college so it was a big thing." Rachel said the following:

> [M]y dad went into the military so he didn't really go to college, and my mom went to some college, but she didn't finish all the way through, so it was kinda like, uh, you can do it first type thing.

Finally, Ashley expressed that she "definitely wanted to come to college because both of my parents didn't get a college education . . . [She] wanted to do something that would benefit others . . ."

These students were enrolled in various major programs within a Health Sciences Department. For all the participants, the decision to attend college was strongly driven by the goal of developing a career in some aspect of health care. For example, Nick said, "I knew college was my only option for what I wanted to do." Carol shared a similar sentiment: "Just because I knew I would be giving myself a better opportunity in my future, so that's really the main reason." They also

Figure 1
Overview of major themes
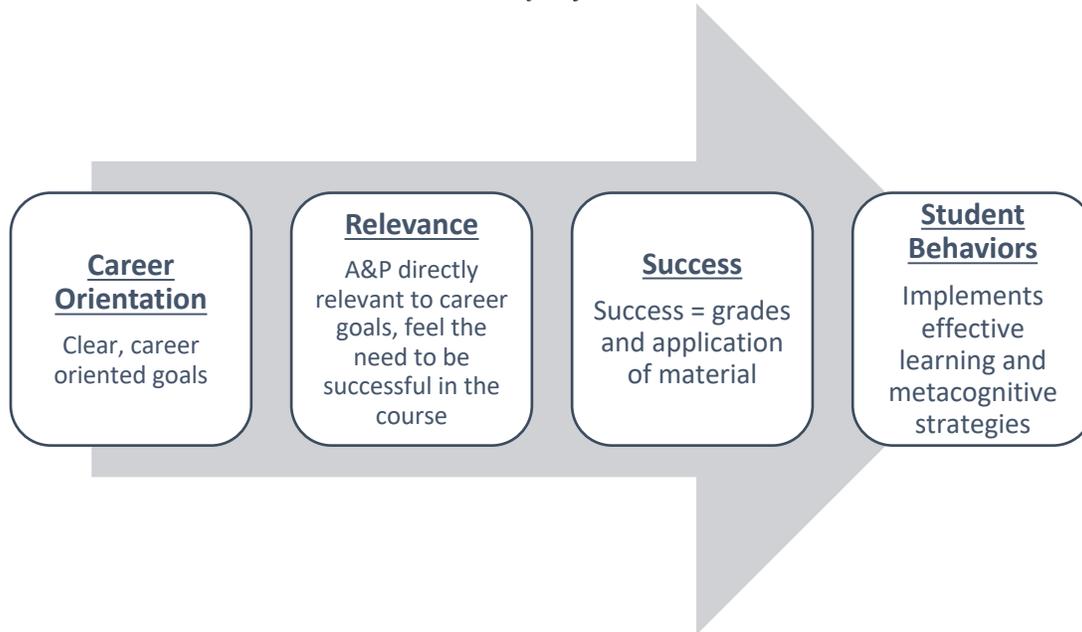
clearly expressed that successfully obtaining a good job minimally requires a college degree, and some noted that many health careers would also require advanced degrees, which would in turn require that they obtain good grades to be competitive in graduate applications. Jason and Desiree, respectively, shared, "[T]o be really successful you kind of need that college degree," and, "[N]othing else even crossed my mind other than going and furthering my education, and then not even to mention that from pretty young I knew that I did want to go in the Health Science field."

Relevance of Anatomy and Physiology

All the participants considered the Anatomy and Physiology class to be foundational and highly important due to its relevance to all health science careers. Not only did they see the course as relevant, but they also understood that success in this course would be a necessary prerequisite for other courses in their major program, for graduate admission, and for their future careers. Participants shared the following:

- "[A&P] relates a lot . . . It's gonna help with trying to get a certified strength and conditioning coach, and I'm gonna need that in the future" (Matt).
- "We have to know anatomy to, like, go head into grad school, and I took that in high school actually, and I really liked it..." (Kate).

- "[Y]ou have to know the parts of the body to see if there, like, . . . you need to know and be able to figure out where an injury is and, like, how to fix it" (Mackenzie)
- "[T]o be an athletic trainer I have to know the anatomy of the human body, how it works. The muscles, the bones and the systems, so it's very important that I know all of the information we are taught in anatomy" (Patricia).

Success: Good Grades and Application

When asked to define academic success in the context of A&P, students identified good grades as very important, as would be expected. Some specifically mentioned that taking a test and then immediately forgetting the material was not desirable or useful, even if the test received a high grade. Additionally, many defined success as the ability to retain the information over time and to apply it to real world situations, including the ability to see connections and interrelationships between different aspects of the material. Taylor expressed both of these ideas in his response: "I mean an A obviously and probably be able [sic] to understand and remember what I learned. Not just remembering it for the course but taking it after like remembering everything." Tori and Erin focused on the usefulness of the content: "Anything that really sticks with you and that you hear and you remember easily and you get where it came from, and you actually understand

the concept . . . it needs to be something you feel like you can use," and, "Building knowledge that I'll remember beyond the classroom."

Interestingly, some students commented on the importance of the content and its connection to future classes or their career. Michael found importance in "obtaining the knowledge and remembering it and applying it to other classes that I will take next year". Rosie and Kate had similar feelings. Rosie noted the following:

> . . . [T]he retention, it takes a while to kind of recall it, but after a couple minutes of hearing or discussing it, I'm, like, oh yeah, this is why this is happening: because it's connected with this or interrelates to that.

She also notes the importance of "being able to apply it in certain things, 'cause being able to apply it is more important than just memorizing it, taking a test, then just forgetting it."

Students Behaviors: Learning and Metacognitive Strategies for Success

The students in this sample have clear career goals and understand that successful mastery of A&P is relevant and important to achieving those goals. In order to be successful, students described a number of strategies they implemented: collaborative work with peers, self-responsibility as a learner, and self-awareness and willingness to change. In addition, the sub-theme of participants' evolution as learners as it relates to their current behaviors emerged from the data. Each of these sub-themes is described here.

Emphasis on collaborative work with peers. One clear strategy that several students used was collaborative work with peers. They recognized that often, on their own, they were not able to understand and master some material. In these situations they sought out and worked with other students to go through the difficult concepts. Much of this activity took place outside of class with roommates, dorm mates, friends, and teammates. It was interesting that this peer activity worked in two directions. They sought help from peers who they felt had mastered the material and could explain it to them effectively in terms they could understand. As Mackenzie stated, ". . . I have a lot of friends on my floor and I'll ask them if they get it and can explain it."

They also defined their own mastery by their ability to help another student understand something that student struggled with. They expressed positive attitudes toward helping to teach other students, both to simply be helpful but also to confirm their own mastery by their confidence in their ability to effectively express the concepts involved, as Hailey described:

> If someone else needs help or someone doesn't understand it, then I can explain it to them, student to student, instead of someone who has a lot of education on it and may not be able to dumb it down but bring it to their level of understanding.

Jackie discussed how she wants to "retain the knowledge so I can pass it on to other students," and Matt said:

> Just getting a good grade on it, knowing it by memory, if I'm able to tell it to one of my friends and they asked me if that was correct and that was correct, then that's my kind of definition of knowing.

Some noted that an explanation from a peer who was facing the same challenges they did was more helpful than working with an instructor who seemed removed from their experience. Rosie highlighted this when she explained, "I sometimes find that your peers are better teachers than your instructors because they can explain it in a way that you might understand. Or they can just kind of walk you through it in a more personalized way." Gazelle discussed a similar benefit to peers working together:

> Sometimes there is a question that everyone has, so…when we're able to sit with other kids in the class and look over all the models and material, I feel—well, not only myself but all the other students, too—we are able to help each other know what they might not understand …to work through questions that both of us might have.

However, not all students felt the collaborative work was beneficial Ashley illustrated this in her response:

> I would do group work, but then I would just get sidetracked….I am a very individual thinker and like I need to figure it out before I can talk to anyone else about it. So if I get something wrong, I wanna see if I can figure it out before I go to a second source.

Overall, most participants discussed the benefits of working together to support understanding and retention of material.

Self-responsibility as learners. When asked about their role in the learning process, students stressed the idea that they were ultimately responsible for their learning in the sense that, while an instructor could teach the material, only they could learn it. Mackenzie explains:

> [B]eing able to take what the teacher tells us and review it on your own to make sure we have a full

understanding of it. …it's my job to listen in class, but when I leave it's my job to make sure I know what I was taught and teach myself what I may have missed.

Michael said the following:

[My] role is to do my part. Listen, ask questions and like it's not the professor's responsibility that I know it. It's his or her responsibility that he or she teaches it, and then I do whatever I want with the information, whether I choose to study or not study.

Hailey summarized this idea when she said, "I believe that you can have the best professor ever but it's on you. Everything is on you. Even if you have a crappy professor, it's on you still." Patricia illustrated this when she noted the following:

To really pay attention and engage with the professor and go on with what they are teaching and showing them that you care by doing well and doing the studying and asking the questions and going to the extra hours

Some also remarked that they did not find it helpful when other students came to class unprepared and remained silent, even though they were confused, since if one person had a question about something, it is likely that others did also. Marie stated: "[S]howing up, being ready, having questions you may have, I mean, I think it's always awkward when a professor's there trying to help you and everyone's saying, 'Oh, I don't have any questions,' but no one's doing that well." Kate said, "If you're just not getting it like when you're reading it, you're just setting yourself up for failure,…so help yourself and, like, always ask for help, too, when you need it, and just be assertive…. Don't lay back."

Self-awareness and willingness to recognize challenges and change approach. The participants interviewed showed a self-aware attitude. They were willing to recognize and think about their areas of strength and areas of challenge. When they were successful, they felt that their learning approach had been validated and planned to continue with those strategies in future. Participants in this study exhibited a growth mindset, believing that they could do better with effort and additional help, rather than giving up when they encountered setbacks.

In those areas in which they were challenged or less successful than they hoped, they were willing to increase their effort and change their learning approach to address those areas to increase their probability of success. As Rosie explained, "There's always room for improvement... I think it's all about allotment of time and how you approach it because sometimes my strengths don't work as well for certain things, so I

need to go back and tweak it." Rebecca added a different perspective related to in-class experiences when she explained:

I get a little frazzled, . . . but after class I'll be like, okay, so that just happened . . . I'll go back later that night and kind of go through the PowerPoint again, see what it was and kinda take my time . . . I just have to like step back, and then go back into it.

Some students, similar to Ken, explain their emotional reactions, but also their perseverance: "I definitely feel bad, but I know that I need to put more work into the homework assignments or the next quiz".

When students were disappointed and frustrated, they noted that they made efforts to understand and analyze where they may have gone wrong, seek help, and develop new strategies. As Hailey stated:

Since this is a class that I am very passionate about, I would probably be very disappointed in myself or if I felt that I didn't do enough or felt that I did do enough to prepare for the assessment then I would probably ask (Instructor X) or somebody that did well to go over it with me.

Jackie made a similar statement but discussed both her role as a learner and also what she would do if she wasn't successful on a test or assignment:

If I didn't study and I didn't do well, I still feel bad, but I know I deserved it, but if it's one that I really studied for and I still received a bad grade I'd be upset, but I'd still go to more TA hours and receive more help.

The following quote from John summarizes this sub-theme well:

[T]here were a couple of times where I felt devastated, I should have done better than that. But I had a support system in the class… So we would be like . . .so listen why don't we go after class and see what we can do and go from there'. …how can we build on failure.

Interestingly, some students also described how family motivated them which supported their ability to keep trying. Charles commented, "My parents and family, they just...they're doing a lot for me and my brothers and sisters, so I just wanna, like, give back." Family also supported them during times of academic challenges which seemed to help them persist. For example, Kate shared the following:

[S]he (Mom) always helps relax me like and not stress out with my exams, and she'll always tell

me, 'You know the information…You're doing a good job.' She helps motivate me and keep me going so doesn't [sic] let me give up.

Evolution as learners. A variety of influences have affected the course of students' evolution as learners, including family, professors, and a developing awareness of the role of their education in future career success, etc. Some noted their lack of, or minimal effort in, high school or middle school and recognized that college would require a greater investment of time and effort. Many noted that an understanding that their career goals required good performance spurred them to work harder and in different ways, particularly in A&P where they saw the direct relevance to the future. As Grace explained:

> In high school I wouldn't even try…This semester I am very more on top of my work, I am more determined and I fixed whatever mistakes I made last semester and I think that's what made me improve. …I realized if I really want to succeed and really pursue a career in the health field I need to be more determined and more on top of my school work or it's never going to happen. … For the first time in my life it (A&P) is a course that means a lot to me.

Jordan explained a similar feeling of the importance of the transition from high school to college:

> [F]rom high school to college, it was more of like I had so much free time here, so I had to do a lot of work outside of class…coming from not knowing much from like a school that didn't teach much to a high school that did, that transition made me understand like that I have to put in work outside of school in order to stay on top of things.

Others noted that their families encouraged hard work and active involvement in their education. As Jackie described:

> I was the first child of 4, and they (parents) were very hard on me. I'm almost like a role model to..my siblings..so I feel like they pushed me a little bit harder to be very successful with my grades.

John described a similar sentiment: "Without him (Grandfather) pushing me, him, my dad, my parents my whole family like they are always tough on me like in a good way . . . like do this now, and then you'll be thankful later."

Discussion

Our goal in this study was to determine the extent and type of metacognitive behaviors practiced by first year anatomy and physiology students majoring in the health sciences. This information will enable us to help students to cultivate and expand their abilities to reflect on their learning in order to achieve greater success in this challenging course.   Semi-structured interviews with a sample of these students conducted at the end of the year-long course sequence yielded four major themes (see Figure 1): 1) These students are very motivated to pursue careers in health care. 2) They perceive Anatomy and Physiology as directly relevant to these career goals and understand that they must be successful in this course to achieve these goals. 3) In addition to good grades, they define success as the ability to retain and apply the material to real world health care-related situations. 4) These students implement effective learning and metacognitive strategies in order to be successful.

Self-Regulated Learning (SRL) is a model which describes "the degree to which students are metacognitively, motivationally, and behaviorally active participants in their own learning processes" (Zimmerman, 2013, p. 137). This involves a feedback loop of 1) Forethought/planning, 2) Monitoring performance, and 3) Reflections and revising approach (Wigfield, et al., 2011; Zimmerman, 2013; Zimmerman & Cleary, 2009). The Forethought phase includes self-motivation, beliefs/values, and the encompassing of self-efficacy, outcome expectancies, task interest, and goal orientation. In the Performance or Monitoring Phase, self-control and self-observation involve self-instruction and help-seeking behavior. In the Self-Reflection Phase, self-evaluation, causal attribution, affect, and adaptive/defensive reactions are seen. Results from this study provided evidence that students in AP I&II are demonstrating SRL. Particularly, the themes of self-responsibility and self-awareness in this study indicate that some students are both monitoring performance and reflecting and revising their approach. Even though students in this study were higher performing students, faculty should consider including opportunities for all students to develop SRL. For example, at the start of the semester students could take a survey related to motivation, values, and career goals. This information could be used to provide feedback to help students see the relevance of the course to values and goals. At the midterm students can complete a reflection on their learning so far – including content they have found challenging, content they have "clicked with" – and discuss strategies they can use during the rest of the semester to support learning.

Having a sample of primarily higher performing students suggests that we may not find the same behaviors in students who were not as successful in the course. Perhaps participants in this study had developed and implemented metacognitive practices in the past and so were able to articulate these ideas when

interviewed and apply them in order to be successful in this course. Understanding the extent to which all students in the course engage in SRL would be informative and would add to the understanding of student behaviors in a gateway health sciences course.

Motivational Value of Healthcare Career Goals

These students almost unanimously and strongly identified the goal of a career in some aspect of health care as a factor in their motivation toward learning, a process of the Forethought Phase. While some were quite specific in their direction (for example, physical therapy, physician assistant), others simply noted health care as a goal but were unsure as to direction. They also clearly understood the relevance of the A & P courses to those goals. In a study on academic relevance of course work in college students, Pisarik and Whelchel (2018) described several domains of relevance, including relation to future courses, vocational goals, and personal growth and development. These same factors were cited by our subjects. In a meta-analysis of self-regulated learning in work-related training, Sitzmann and Ely (2011) noted goal level, persistence, effort, and self-efficacy as having the strongest effects on learning. Specific goals expressed by medical students in a clinical environment were also found to influence self-regulated learning, along with personal and social factors (Berkhout et al., 2015). Our findings support this research as we found that students felt A&P connected to both their professional goals and also future courses they will take. In addition, students mentioned a strong family influence as a personal factor, which has been shown to support SRL (Berkhout et al., 2015). This suggests that the applications of research relating to medical students may also apply to broader health science students as well. Gaining a deeper understanding of what motivates students in a foundational course such as A&P can help instructors develop strategies to support student motivation and success. Faculty should consider integrating strategies to support connections to careers in the course. These opportunities for integration include incorporating more specific anecdotes and case studies using a variety of careers as context, including assignments in which students need to apply learning in various situations, and building relationships with students so that they can support the connections students make to the real-world applicability of content (regardless of career).

Task Value and Relevance

The students in this study clearly expressed the understanding that the anatomy and physiology course is directly relevant to any health care field. They also understood that good performance in the course would be necessary for success in succeeding courses in the undergraduate program, admission to advanced degree programs, and eventual clinical practice. This theme could be considered part of the forethought phase of self-regulation (Zimmerman, 2013). Pisarik and Whelchel (2018) term these factors as having direct academic relevance, in that a course is required for the degree and is a pre-requisite to others in the academic program, as well as direct occupational relevance, in that the course is directly applicable to health care careers.

Metacognitive Strategies and Self-Regulated Learning

Findings from this study provide evidence that students in a gateway A&P course are implementing aspects of SRL. In particular, students' strong career orientation, along with their understanding of the relevance and importance of A&P (task value, goal orientation), caused them to devise a set of strategies for preparing for study in advance of various assessments. This is driven by a strong sense of self-responsibility for their learning as noted also by Zimmerman and Kitsantas (2005). In addition, Kitsantas and Zimmerman (2009) found that self-efficacy for learning correlated with perceptions of responsibility and predicted course grades. Interestingly and somewhat unexpectedly, these subjects clearly prioritized their responsibility in the learning process.

The students in this sample clearly showed that they were reflecting on tests and assignments returned to them and comparing their performance to their prior preparation in the self-reflection phase of SRL. When they did well, they intended to continue with the types of preparation they had been using. When their performance did not meet their goals and expectations, they assessed what they felt they needed to change to improve their performance and took action to do better. Some students clearly recognized their evolution as learners from high school to college, particularly that high school study strategies were not going to be sufficient or effective for college level work in science. This recognition helped to motivate change. In some cases, these actions were personal and individual, for example studying further ahead, investing more time, changing the approach by emphasizing the greater use of the text, changing the study environment, changing pre-class and in-class behaviors, etc.

A key component in the Performance Phase of SRL is help seeking behavior. These subjects seemed quite comfortable with seeking out and utilizing opportunities for help. As expected, this could involve seeking out instructors and teaching assistants for additional explanations of the material and help with study

strategies. Many students strongly emphasized the role of social and collaborative learning. Turning to and working with peers, both in and out of class time, seemed to be a very important component for improving learning. It may be helpful for faculty to build in opportunities for peer to peer teaching and review, group quizzes, and team-based learning. Instructors could also focus on creating a culture in which help-seeking is encouraged and including metacognitive activities into the course (e.g., an exam wrapper where students reflect on their test performance and what can be done differently next time).

Performance and Growth Mindset

Underlying performance monitoring and strategies for change seem to be a belief that they can do better: self-efficacy. Doing better to these students did not simply mean better grades, described as performance goals by Blackwell et al., (2007) and Elliott and Dweck (1988). Rather, they identified mastery goals, which they defined as the ability to retain the material in future courses and in practice and apply it appropriately to concrete or real-world situations. This is evidence of the "growth mindset" which may lead to increased persistence in situations of difficulty or failure (Blackwell, et al., 2007; Elliott & Dweck, 1988).

An important feature of SRL is the ability to reflect on performance and to revise one's approach. This requires the ability to control cognitive process and emotions (Wigfield, et al., 2011). Several students stated that the positive emotions they experienced when doing well only confirmed their strategies and increased their motivation without leading them to slack off because they were in control. In the case of negative emotions resulting from failure or doing less well than expected, the reactions seemed to be temporary and were attributed to their own perceived ineffective behaviors and study strategies. Given that they attributed the situation to personal factors within their control instead of to external forces, rather than giving up, it seemed to motivate them to exert greater or different types of efforts such as seeking help, etc. In no case did students express any sense that a poor result would cause them to give up on the course. This is also evidence of a growth mindset (Blackwell, et al., 2007; Elliott & Dweck, 1988). While students in our study demonstrated aspects of a growth mindset, studies have shown that interventions can support the development of a growth mindset in a range of students (Broda et. al., 2018; Kalman, Sobhanzadeh, Thompson, Ibrahim & Wang, 2015; Wagener, 2016). Faculty should consider including strategies to encourage and develop a growth mindset as part of the course or as a separate intervention.

Our study interviewed primarily first-year students in anatomy and physiology. Stanton, Neider, Gallegos, and Clark (2015) describe a continuum of metacognitive regulation in introductory biology students that ranged from not engaging to struggling to emerging and developing. By these criteria the students described in the present study fall in the emerging category, knowing what to do, but they may or may not follow through, and in the developing category, following through on their insights for change to enhance learning. We have no evidence as to whether all students followed through with their plans for change, though some clearly stated that the change in approach resulted in improved performance on subsequent assessments.

Implications

The ability to regulate and monitor the quality of one's own learning process is an essential skill for individuals in many disciplines. Therefore, the purpose of this study was to use a grounded-theory, qualitative approach to gain a deeper understanding of students' SRL processes in this gateway course that is critical for success in their academic programs and their future professions. Based on the findings, one of the practical implications of this study focused on the connection between professional goals and the coursework in which students are engaged. It is important for instructors to gain a deeper understanding of what motivates students in a foundational course such as A&P, as well as other courses, in order to develop strategies to support student motivation and success. As described above, there are strategies that faculty can use to identify and make connections to students' values and motivations that may enhance success in courses such as A&P.

Students in this study clearly expressed the understanding that good performance in a course will be necessary for success in future academic coursework and for eventual clinical practice. Therefore, it is important to help students make connections to their personal and professional goals based on how their academic courses connect to those goals. This can be done through class activities, assignments, and relationship building with students. Based on results from this study, helping students make these connections may support their motivation and overall success in the course.

Findings from this study provide evidence that students in a gateway A&P course are implementing aspects of SRL. The subjects were clearly reflecting on their learning and making changes to their behaviors based on this reflection. However, these were also higher performing students, so we do not know habits of other students in the courses. Other research has suggested the benefits of SRL, metacognition, and mindset for a range of students. In conjunction with our findings, an important implication is that faculty should

consider strategies for supporting the development of metacognitive strategies and a growth mindset in their students to support their success, especially in gateway courses such as A&P.

Limitations and Future Directions

It is important to note several limitations of the current study. The participants were traditional-aged college students attending a smaller, private college. A convenient, purposeful sampling was implemented to recruit students enrolled in the Anatomy and Physiology course sequence. In addition, the participants had higher GPAs, which may not be representative of the average students in health sciences. It has been noted by Zimmerman and Kitsantas (2014) that students describing more developed SRL behaviors do better academically. Also, the current study was not gender balanced (74% women, 26% make men), which may have altered results. Nevertheless, the current study is a first step in gaining a deeper understanding of students' SRL processes in a gateway course that is critical for success in their academic programs and their future professions. Future studies might examine differences between majors, for example, health sciences majors and liberal arts majors. Future studies might also examine the applicability of these findings to different populations such as nontraditional or part-time community college students.

Studies have indicated that implementation of strategies to help students improve metacognitive skills can be effective (Tanner, 2012; Zhao, Wardeska, McGuire, & Cook, 2014). Medina and colleagues (2017) have described a number of strategies for improving metacognitive skills of reasoning, comprehension, and problem solving in health professions education. The results of this study will help us to design and implement strategies like this targeted to this course and to pre-health professional students.

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Appendix

Interview Questions

Metacognition in A&P: A Qualitative Inquiry

The purpose of this study is to examine students' understandings and perceptions of learning and metacognition in the context of an A&P course. A secondary purpose is to examine students' self-reported use of metacognitive behaviors in A&P.

Relevance

1. **What are the reasons you decided to attend college? Were there other jobs or activities you also considered?**

    What goals do you have as a college student?

    What are your professional goals?

2. **What is your major? Why did you choose this major?**

    How does A&P relate to your major? To your possible professional goals?

3. **Please describe what being successful in A&P would look like at the end of the semester.**

    Do you feel motivated to be successful in A&P? Why or why not?

    Please describe how you think your motivation level affects your ability to be successful in the course.

4. **What are your strengths as a learner in AP? How do you know?**

    What are your weaknesses or areas for improvement? How do you know?

    Are these strengths and weaknesses similar to the strengths and weakness in other courses? Why or why not?

    How can you build on your strengths or address your weaknesses?

Learning/Being a Learner

5. **What does the term "learning" mean to you?**

    Follow up if necessary with: How would you describe the concept of "learning"?

6. **Who or what has shaped you as a learner?**

    Do you think you have changed as a learner over time?

If yes, how? Why?

If no, why not?

7.   Please describe what you do to learn A&P content/material.

Do you think it is effective? Why or why not?

If they say yes, ask: do you think there is anything you could do to be a more effective learner?

If they say no, ask: Do you think you could make your learning more effective? Why or why not?

Do you do the same things in other courses? Why or why not?

If yes, how does it differ?

Metacognitive Behaviors

8.   Imagine you are in an A&P lecture or lab. You have been following along and understanding the content but now you are getting confused or are lost in class. How do you feel? What do you do? Why do you do this?

How will you know if your strategy for dealing with the confusion is successful?

Now imagine that you are doing the reading for class and the same thing happens. How do you feel? What do you do? Why do you do this?

9.   Imagine you are in class and the content "clicks" and you really "get it". How do you feel? What do you do? Why?

10.   Imagine you just got a test or assignment back in A&P, you did really well. How do you feel? What do you do? Why do you do this?

What if you didn't do well? How do you feel and what do you do? If you try to do better, how will you know if your strategy was effective?

11.   Please describe what you do to prepare before a class or lab section.

Please describe what you do during lecture and lab.

Please describe what you do after class.

12.   How would you describe your role in the learning process in A&P?

Follow up with, what is your job as a student in learning the content of A&P? (Only if   necessary)

13.   Can you tell me what you think the job of the professor is in your learning the content A&P?

14.   Is there anything else you would like to add?