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Using a Learning Philosophy Assignment to Capture Students' Metacognition and Achievement Goals

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Using a Learning Philosophy Assignment to Capture Students' Metacognition and Achievement Goals

Abstract
As key components of self-regulated learning, metacognition and goal orientation have been tied to improvements in academic achievement. Some research supports a bidirectional relationship between metacognition and goal orientation in which they promote each other as well as learning outcomes. We created a learning philosophy assignment (LP) to encourage students' consideration of their learning strategies and goals resulting in a record of students' metacognition. Research suggests that low-achieving students may have different metacognitive capabilities and learning goals and as such may be differentially impacted by the assignment. This paper considers the content of the LPs. Students were split into achievement quartiles to explore any patterns in metacognition or learning goals distinct to achievement level. Our content analysis confirms that the LP was successful in documenting metacognition and learning goals in all students. There were some differences related to achievement level.

Les composantes clés de l'apprentissage autonome, la métacognition et l'orientation vers un but, ont été liées aux améliorations dans la réussite des études universitaires. Certains travaux de recherche soutiennent qu'il existe une relation bidirectionnelle entre la métacognition et les objectifs en matière de réussite du fait qu'ils se favorisent l'un l'autre et qu'ils favorisent les résultats de l'apprentissage. Nous avons créé un travail de philosophie d'apprentissage pour encourager les étudiants et les étudiantes à prendre en considération leurs stratégies et leurs objectifs d'apprentissage afin d'en arriver à un dossier de la métacognition des étudiants et des étudiantes. La recherche suggère que les étudiants et les étudiantes peu performant(e)s pourraient avoir des capacités métacognitives et des objectifs d'apprentissage différents et pour cette raison, pourraient être touchés différemment par les travaux demandés. Cet article examine le contenu des travaux de philosophie d'apprentissage. Les étudiants et les étudiantes ont été divisés en quartiles de réussite afin d'explorer les tendances en métacognition ou les objectifs distincts d'apprentissage pour atteindre les niveaux de réussite. Notre analyse du contenu confirme que le travail de philosophie d'apprentissage a permis de documenter la métacognition et les objectifs d'apprentissage chez tous les étudiants. Il y avait quelques différences liées au niveau de réussite.

Keywords
metacognition, mastery goals, performance goals, self-regulated learning, learning philosophy; métacognition, objectifs de maîtrise, objectifs en matière de réussite, apprentissage autonome, philosophie d'apprentissage

Cover Page Footnote
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Most educators would agree that successful university graduates are independent learners. Independent learning requires self-regulation, but self-regulation requires effort, and effort is always a choice. Understanding why and how students self-regulate helps educators understand how they can encourage self-regulated learning (SRL) in their classrooms. SRL has been defined as "an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviour, guided and constrained by their goals and the contextual features in the environment" (Pintrich, 2000b, p. 453). Other definitions of SRL have been proposed (e.g., Winne, 2001; Zimmerman, 1990), but key to most frameworks are the assumptions that students can control their learning processes and that self-regulatory activities can directly affect achievement (Pintrich, 2000). Two important components of SRL are goal orientation and metacognition; much of the evidence that links SRL to academic achievement comes from research findings that goal orientation and metacognition impact academic achievement (de Boer et al., 2018; Dent & Koenka, 2016; King & McInerney, 2016; Vrugt & Oort, 2008).

In SRL theories, goals act as both a guide and standard for learning (Pintrich, 2000b). Because students can use their goals to assess both the results and process of learning, goals provide useful feedback for regulating the learning process. Some models describe goal setting as just one SRL strategy among many (Zimmerman, 1990). However, achievement motivation theorists suggest that goals can guide learning behaviours in substantial ways (Ames, 1992; Dweck & Leggett, 1988; Elliot & Harackiewicz, 1996). Goal orientations are the reason students choose to put the effort into self-regulated learning, why they choose to complete a learning task, and why they choose to write the exam. Goal orientations can trigger different cognitive-affective-behavioural patterns (Ames, 1992; Dweck & Leggett, 1988; Elliot & Harackiewicz, 1996). More importantly, some goal orientations produce useful patterns and others produce maladaptive patterns. Dweck and Leggett (1988) proposed two goal orientations: mastery goals (originally termed learning goals) and performance goals. Mastery goals are focused on increasing competence, skill, and/or mastery, and are associated with useful cognitive-affective-behaviour patterns (Ames, 1992; Dweck & Leggett, 1988; Elliot & Harackiewicz, 1996). For example, mastery goals are associated with challenge seeking, positive affect, and increased effort in the face of difficulty. Mastery goals have been correlated with improved ability, greater task enjoyment, and deep learning strategies. In contrast, performance goals are focused on proving competence and/or avoiding perceptions of incompetence and are associated with maladaptive cognitive-affective-behaviour patterns (Ames, 1992; Dweck & Leggett, 1988; Elliot & Harackiewicz, 1996). For example, performance goals have been associated with challenge avoidance, negative affect, and decreased effort in the face of difficulty. Furthermore, performance goals have been correlated with decreased ability, reduced task enjoyment, and superficial learning strategies.

Metacognition, thinking about your own thinking (Flavell, 1979), makes self-regulation possible (Dent & Koenka, 2016). If goals are the why of SRL then metacognition is the how. Confusion exists regarding exactly how metacognition and self-regulation are related; metacognition has been investigated as an independent concept as well as a sub-process of SRL (Dinsmore et al., 2008; Veenman et al., 2006). Although metacognition was first conceptualized outside of an SRL framework, many researchers agree that theoretical conceptualizations have more similarities than differences (Dent & Koenka, 2016; Ohtani & Hisasaka, 2018). Metacognition is commonly divided into two subcategories: metacognitive knowledge and metacognitive regulation (Jacobs & Paris, 1987; Schraw & Moshman, 1995). Metacognitive knowledge includes one's awareness of their own cognitive processes (Jacobs & Paris, 1987; Pintrich, 2002; Schraw & Moshman, 1995). Because cognitive processes cover substantial ground, metacognitive knowledge is often subdivided into declarative, procedural, and conditional knowledge (Jacobs & Paris, 1987; Schraw & Moshman, 1995). Regardless of the label, metacognitive knowledge includes an awareness of yourself as a learner: knowledge about your conceptual understanding (what you know) and your strengths and weaknesses as a learner (e.g., strong reader, weak writer) (Jacobs & Paris, 1987; Pintrich, 2002; Schraw & Moshman, 1995). It also includes knowledge about learning tasks (e.g., level of difficulty), the learning strategies you can employ to learn (e.g., concept map), how to use a learning strategy, and the conditions under which a strategy should be employed (e.g., different disciplines).

Metacognitive regulation includes activities that control our thinking and learning (Jacobs & Paris, 1987; Schraw & Moshman, 1995). Metacognitive knowledge is a prerequisite for regulation; while conceptually distinct, metacognitive knowledge and regulation are strongly correlated and often difficult to separate in practice (Ohtani & Hisasaka, 2018; Vrugt & Oort, 2008). Self-regulated learning theories suggest many metacognitive strategies that students can use to regulate their learning (see Pintrich, 2000; Zimmerman, 1990), but most activities can be subsumed within three categories: planning, monitoring, and evaluating (Jacobs & Paris, 1987; Schraw & Moshman, 1995; Vrugt & Oort, 2008). Planning involves choosing appropriate learning strategies and allocating resources. Planning requires metacognitive knowledge; you cannot choose a strategy if you do not know what it is, how to do it, or when to use it. Monitoring includes an ongoing awareness of your conceptual understanding and your learning outcomes (Jacobs & Paris, 1987; Schraw & Moshman, 1995; Vrugt & Oort, 2008). Students can monitor their learning strategies and task performance. Many SRL theories assume that students also monitor their goals, emotions, and external environment in addition to the behaviour and cognitive processes associated with learning (Pintrich, 2000b). Evaluating involves assessments of comprehension, task performance, learning strategies, and learning outcomes (Jacobs & Paris, 1987; Schraw & Moshman, 1995; Vrugt & Oort, 2008). Planning, monitoring, and evaluating make up the feedback loop of self-regulated learning (Dent & Koenka, 2016; Zimmerman, 1990). Students make a plan to meet a learning goal, monitor their learning, and then evaluate their learning; this information can then instigate new plans to meet learning goals.

Metacognition has been found to correlate with and predicts academic achievement (de Boer et al., 2018; Dent & Koenka, 2016; Ohtani & Hisasaka, 2018). Metacognition may play a compensatory role in education; while metacognition and intelligence are correlated, metacognitive skills can contribute to academic achievement beyond intellectual ability (Ohtani & Hisasaka, 2018; Veenman et al., 2006). As such, studies which prompted metacognition in the classroom have now occurred across multiple disciplines: chemistry (Zhao et al., 2014), biology (Sabel et al., 2017; Stanton et al., 2015), health sciences (Colthorpe et al., 2017), and architecture (Kurt & Kurt, 2017). Metacognition has been found to positively correlate with critical thinking skills (Magno, 2010) as well as improve problem-solving ability (Sandi-Urena et al., 2011) and perceived self-efficacy (Zhao et al., 2014). Metacognition has also been suggested to improve domain-specific learning outcomes (Colthorpe et al., 2017; Kurt & Kurt, 2017; Zhao et al., 2014).

A subset of studies indicates that metacognitive abilities may differ in student subpopulations. Low-achieving students may have less developed metacognition and be less capable of implementing metacognitive strategies even when prompted (Händel & Fritzsche, 2016; Sebesta & Bray Speth, 2017; Ziegler & Montplaisir, 2014). The unskilled-and-unaware effect (i.e., the Dunning-Kruger effect) is found when low-achieving students overestimate their academic performance and are unaware that their judgments are inaccurate (Kruger & Dunning, 1999). These learners lack effective monitoring skills. However, Händel and Fritzsche (2015) found that low-achieving students who overestimated their performance had little faith in their judgments: they did not trust their monitoring skills. Interestingly, Ziegler and Montplaisir (2014) observed that high- and low-achieving students can be equally inaccurate in their monitoring judgments. That is, the magnitude of error is similar, but the direction is different: high-achievers underestimate and low-achievers overestimate. These differences have led some studies to suggest that metacognitive interventions might differentially impact low-achieving students (Colthorpe et al., 2017; Mynlieff et al., 2014). Mynlieff et al. (2014) found that all students who engaged in a metacognitive activity (i.e., exam correction) improved academic performance but low-achieving students showed greater learning gains. Meanwhile, Colthorpe et al. (2017) found that high-achieving students disregard prompts to adjust their learning strategies because their grades are adequate. In contrast, low-achieving students are more likely to make appropriate changes to their learning strategies after metacognitive reflection and as a result, their academic performance improves.

In addition to being individually tied to academic achievement, metacognition and goal orientations may also interact to produce learning gains (Coutinho, 2007; King & McInerney, 2016; Vrugt & Oort, 2008). Metacognition may act as a mediator in the relationship between goal orientation and achievement. Coutinho (2007) found that mastery goals predicted metacognition and both mastery goals and metacognition predicted GPA. Vrugt and Oort (2008) supported Coutinho's findings when they concluded that mastery goals predicted metacognition and metacognitive strategy use (i.e., metacognitive regulation activities like planning and monitoring) which in turn had a positive impact on exam scores. However, this relationship is not necessarily unidirectional. King and McInerney (2016) agree that mastery goals predict metacognition, but they also found that metacognitive strategy use predicted later mastery goal adoption. Furthermore, they did not find that mastery goals and metacognition led to academic achievement; instead, they found that academic achievement predicted mastery goals and metacognition. While directionally unclear, a relationship does exist. As such, educational interventions that promote metacognition and/or mastery goals may be useful for improving academic achievement. Moreover, promoting metacognition may improve mastery goals and vice versa.

Motivated by the research on goal orientation and metacognition, we created a learning philosophy assignment (LP) which enabled students to consider their learning goals and record their metacognition. Potentially, having students be metacognitive and aware of their learning goals may improve learning outcomes. However, we must first understand what metacognitive thinking and goal orientation look like in undergraduate students across year-level and achievement level. The purpose of this paper is to explore the content of students' LPs. We used qualitative methods to analyze the LPs for evidence of metacognition and goal orientation. We had several research questions to explore:

1. Does the LP indicate metacognition by students and a consideration of their learning goals?
2. What types of learning goals exist in undergraduate students?
3. What patterns exist for different metacognitive subcategories (e.g., metacognitive knowledge vs. regulation)?
4. Do low- and high-achieving students show different patterns of metacognitive thought and/or goal-orientation?

Method

Participants and Context

Participants were students in biology classes at the Augustana Campus of the University of Alberta between the fall of 2015 and winter of 2019. Students who completed the LP came from four first-year biology classes (*n* = 89), three second-year biology classes (*n* = 42), and four fourth-year biology classes (*n* = 28). Course levels, topics, and dates are listed in Table 1. Two teachers rotated the teaching of introductory biology, but the LP was introduced using the same instruction sheet (Haave et al., 2018). The second- and fourth-year biology classes were all taught by the same instructor.

The LPs were graded by the study's lead investigator and his research assistants. In some classes, the LP was one alternative contributor to students' final grade and in other classes, it contributed to all students' final grade (Table 1). When the LP was not required to be completed by all students, students were sometimes given the choice between completing the LP or completing an alternative assignment directly related to course content. In other years, students who completed the LP received a slightly lowered weight on their midterm and final in order to compensate for the weight of the LP (Table 1). Regardless, when completed, the LP contributed to students' final course mark.

Primarily, each class contained students at the same year-level as the course-level (e.g., 100-level biology was mostly first-year students); however, students were not eliminated from the analysis if their year-level did not match the course-level. Additionally, some students were exposed to the LP more than once: 20 students in the 200-level cohort and 11 students in the 400-level cohort completed an LP in a previous course.

Students were divided into four academic achievement quartiles (i.e., low, mid-low, mid-high, and high) at each year-level (i.e., 100-level, 200-level, and 400-level) based on their midterm exam marks using a median split. When a student's midterm mark fell directly on the median or quartile the student's achievement classification was always rounded up (e.g., If the median is 69% and student's grade is 69%, that student goes into the mid-high condition, not the mid-low). Students were split into these quartiles within the context of the individual course and only the students who completed the LP were included when determining the quartiles. After grouping students into quartiles within their individual course, all students within a year-level and a quartile were combined to form the final groupings (e.g., all low achieving students in 100-level courses are grouped together).

An ANOVA confirmed that students in each course (at a single year level) were not academically different (based on their midterm mark) thereby justifying the combination of all individual courses at each year level into one larger cohort. Additionally, a comparison of participating and non-participating students has been reported elsewhere (Haave et al., 2018); we found no initial differences between students who self-selected into the study versus those who did not. This study was approved by the University of Alberta research ethics board (Project #56316). Students' consented to the use of their LPs, and each student's work was anonymized and assigned a unique study number.

Table 1
Details of the Courses and Context under which the LP was Offered

Semester & Year	Course Level	Course Topic	LP Required (Y/N)[1]	% Of LP Participation[2]	Contribution To Course Final Mark
Fall 2015	100	Introductory Biology	Y	100	Deleted lowest in-class assignment (4 of 5 assignments worth a total of 5%).
Winter 2016	200	Biochemistry	N	51	5% removed from both midterm and final exams.
	400	History and Theory of Biology	N	61	Students could complete an e-portfolio or write the final exam. The LP was 20% of the e-portfolio which amounted to 9% of their final grade.
Fall 2016	100	Introductory Biology	N	24	5% removed from both midterm and final exams. Thus, the LP contributed 10% toward students' final grade.
	200	Molecular Cell Biology	N	49	Students could complete a research poster or a learning dossier. The LP was 25% of the learning dossier amounting to 4% of their final grade.
	400	History and Theory of Biology	N	40	Students could complete an e-portfolio or write the final exam. The LP was 20% of the e-portfolio amounting to 9% of their final grade.
Fall 2017	100	Introductory biology	Y	100	No incentive, the LP contributed 1% towards the final grade.
Winter 2018	200	Biochemistry	N	54	Students could complete the LP or a short research paper, both of which contributed 10% to their final grade.
	400	History and Theory of Biology	N	38	All students completed a writing dossier worth 20 or 30% of their final. The dossier contributed 30% for those who included an LP with their dossier.
Fall 2018	100	Introductory Biology	Y	100	No incentive, the LP contributed 1.4% towards the final grade
Winter 2019	400	History and Theory of Biology	N	56	All students completed a writing dossier worth 20 or 30% of their final. The dossier contributed 30% for those who included an LP with their dossier.

[1]Required in the sense of whether all students in the class were required to complete an LP (Y) vs whether this was one choice among different possible assignments or in exchange for lower weighting of term exams (N). In all cases, a completed LP contributed to students' final course grade.
[2]Percentage of students enrolled in the class who completed an LP.

Learning Philosophy Assignment

The LP was designed to encourage students to consider their learning strategies and goals resulting in a record of their metacognition. The LP asked students a series of questions regarding what, why, and how they learn (Table 2; Haave et al., 2018). Questions were geared towards encouraging both metacognitive knowledge and regulation; however, questions and feedback focused on learning strategies, not content comprehension (Haave et al., 2018). Recognizing and/or monitoring comprehension is a useful strategy providing feedback for self-regulation, and it was certainly coded when present. However, we tried to discourage students from focusing on an in-depth discussion of what they did and did not understand. We did not want the LP to be the tool students used to monitor their comprehension (this is the purpose of the midterm exam). Instead, we focused on getting students to articulate what learning strategy they used and why (which could certainly include a discussion of monitoring comprehension to adjust study strategies). Students answered the questions in a two-page essay and submitted two drafts. Draft one was completed right before the midterm, and draft two was completed during the last week of classes.

Table 2
Questions Included in the Learning Philosophy Assignment

Learning Philosophy Questions
• What, how, and why did you learn?
• How does learning feel and affect you?
• Does the material have future relevance?
• Is your learning/education helping you to develop into the person you wish to be?
• Did you receive and/or incorporate feedback?
• Would you change your learning approach

Students were given substantial typewritten feedback on their midterm draft: feedback was directed to each student individually. Typewritten feedback was shared among markers to ensure consistency within and between courses. Feedback included suggesting learning strategies (e.g., retrieval practice) and helping students understand why these strategies were useful (i.e., evidence-based practice) and how to employ them (e.g., spaced practice rather than cramming). Feedback also included questioning students on whether they thought their learning strategies had been effective on the midterm, why or why not, and if they needed to make any changes to their learning strategies prior to the final exam. Additionally, feedback encouraged students to deepen their reflection, for example, considering their learning strategies in courses outside the biology sphere, or considering how their learning might be relevant to their after-degree goals. As a result of students reflecting on the effectiveness of their learning strategies, the LPs documented students' metacognitive knowledge and regulation.

Student grades were formative (i.e., the midterm draft mark was replaced with the final draft mark if the final draft mark was greater than the midterm mark), and students were explicitly asked to address the midterm feedback in their final drafts. The two-page limit was strictly enforced to ensure the assignment was not onerous. Therefore, students could not always directly respond to all the feedback offered. Instead, the final draft contained what students considered to be the most important aspects of their learning philosophy. Identifying these key components of their learning philosophy was part of their task. Additionally, it was explained to students that a learning philosophy did not have a right or wrong answer, but that there was an opportunity to better articulate their answer and/or deepen their critical reflection. Their mark was based on the depth of this reflection.

Qualitative Data Analysis

The main goal of the content analysis was to confirm that the LP did, in fact, document students' metacognition and consideration of their learning goals. To a certain degree, the content analysis was situated in a grounded theory framework. Although we knew we were looking for evidence of metacognition and goal orientation, we did not know exactly what that would look like. As such, the concepts and categories were developed in large part from the data. The content analysis was an iterative process that began with open, exploratory coding for themes. As each new class was coded, the categories were compared with earlier classes to look for overlaps and/or new categories. Whenever the concepts and categories changed, previously coded material had to be recoded to align with the developing codebook. Once the complete codebook was created, coding was somewhat more selective. While we never sought a specific answer, categories became more clearly defined, and it was easier to assign certain writing patterns to a specific category. Although the coding was completed by a single research assistant, conversations with the lead investigator were frequent and ongoing. The coding scheme was continually considered within the context of existing literature on metacognition and goal orientation, and our conversations are where we interpreted our own coding in light of the existing literature. Each LP was coded three times. The first two coding sessions included reading the LP in full, coding line by line for all existing categories and any new concepts that were apparent in the text. The third coding session took place after a review of what was coded across an entire class. Using NVivo, we were able to review the different categories and consider any gaps in the coding where entire metacognitive categories were missing. We could then re-analyze the assignments to ensure there truly was no evidence of a specific category in the texts, rather than a lack of recognition on the researcher's part. After reviewing for gaps, the LPs were searched for keywords that were commonly associated with missing categories. For example, if it became apparent that none of the LPs in a class had been coded for evidence of failure to enact a study plan, the assignments would be searched for commonly associated terms like "have not," "could not," and "did not." The LPs were loaded into NVivo as individual cases. Each case was a single student assigned two attributes: an achievement level (i.e., low, mid-low, mid-high, and high) and a specific course designation (i.e., semester and course code). Once the coding was complete, the number of cases (i.e., individual students) who contributed to each coding category was counted and described as a percentage of the total number of students within that quartile and year level. Additionally, queries were run to extract student counts based on achievement and year-level. Although quantifying the data makes a statistical analysis theoretically possible, we did not have a large enough sample size to pursue further analysis. We cannot make any causal conclusions from this data set but we can indicate the relative number of students who were thinking in a particular way.

The literature on metacognition attempts to provide us with a clear theoretical distinction between metacognitive knowledge and metacognitive regulation; however, there also exists some disagreement over what falls under each category. Ideally, a classification framework should be exhaustive and mutually exclusive; that is, all examples of metacognition should fit somewhere, and no category should overlap with any other. Unfortunately, reinterpretations of metacognitive knowledge and metacognitive regulation have removed the exclusivity that makes a classification system function well. For example, Schraw and Moshman (1995) broadly define metacognitive knowledge as: "what individuals know about their own cognition or about cognition in general" (p. 352). They then define the subcategory declarative metacognitive knowledge as "knowledge about oneself as a learner and about what factors influence one's performance" (p. 352). Meanwhile, they define monitoring (a subcategory of metacognitive regulation) as "one's on-line awareness of comprehension and task performance" (p. 355). In contrast, Stanton et al. (2015) define metacognitive knowledge as "the ability to identify what we do and do not know" and metacognitive regulation as "the actions we take in order to learn" (p. 2). These contradictory definitions make it difficult to accurately categorize a student's metacognitive statement into a single distinct category. For example, according to Schraw and Moshman (1995), a statement like "I understand concept X" would be an example of monitoring, and therefore metacognitive regulation, but Stanton et al. (2015) would classify this as metacognitive knowledge.

Other contradictions exist across the literature. According to Coutinho (2007), metacognitive knowledge involves a student's knowledge of their skills and best practices as well as when to implement these strategies. This definition aligns with Schraw and Moshman's (1995) understanding of the subcategories of metacognitive knowledge (declarative, procedural, and conditional). Conditional knowledge would include knowing under what conditions a certain cognitive action was most suited. Hrbáčková et al, (2012) also agreed with Schraw and Moshman (1995), defining metacognitive knowledge as an awareness of one's own cognitive process but they interpreted this to mean "knowledge of how one learns and acts" (p. 1805). The problem here is the word act. If Stanton et al. (2015) are defining regulation as "the actions we take in order to learn" (p. 2), then definitions of metacognitive knowledge that move beyond awareness into action begin to imply regulation and control. The problem with applying subcategories like conditional knowledge is that knowing when and why to apply a cognitive action (i.e., a learning strategy) begins to sound very much like regulation when reading a textual statement. If you are purposely choosing an activity to control your learning outcome or planning to use a specific strategy, then you are already crossing into metacognitive regulation. These categories are not easily separated in a student's writing; the meaning of a piece of ambiguous text can sometimes be interpreted in more than one way. It is not always clear if a student simply has declarative knowledge of a subject, that is, I know of concept X, or if they are trying to monitor their comprehension, that is, I understand concept X. Additionally, most statements students make about their learning cut across these categories. Theoretical frameworks do not account for the fluidity of thinking. When writing, students frequently move back and forth between metacognitive knowledge and metacognitive regulation within the same sentence.

During the coding process, we attempted to encompass the somewhat contradictory definitions of metacognitive knowledge and metacognitive regulation into our coding scheme. As a result, the categories are not mutually exclusive. Some statements about metacognition crossed classification boundaries and needed to be coded within more than one subcategory.

Students' LPs were coded for evidence of metacognitive knowledge which included awareness of conceptual understanding and learning strategies (Table 3). Stanton et al. (2015) also make a distinction between conceptual understanding and learning strategy. We have included these distinctions as a subcategory of metacognitive knowledge and extrapolated this idea into metacognitive regulation (specifically monitoring). This decision was a reaction to the content of the LPs. We asked students specifically "What did you learn?," which resulted in many student responses about conceptual understanding. Additionally, we asked students "What learning strategy did you use?," which, in turn, led many students to recognize and/or monitor their learning strategies. Metacognitive knowledge was not further subdivided (e.g., declarative, procedural, conditional) because many written statements included components of more than one category. Instead, any statement that included one or all of these elements was coded as metacognitive knowledge: an awareness of how the student learned, what strategies they were using, how to use them, why they were using them, and when to implement them. As per Stanton et al. (2015), we have included a learner's knowledge of what they do and do not know as metacognitive knowledge. During metacognitive regulation, a learner uses that information to their benefit. For example, stating a definition is simply knowledge. Monitoring, however, moves beyond knowledge when a learner realizes that they know the definition of a term and thus no longer need to review that material. To our mind, regulation occurs when knowledge is used.

Our initial attempt at coding made it quickly apparent that the (mostly) distinct classification in the literature was not always apparent in practice. Therefore, we adjusted our classifications from the text up. Unlike some researchers who prompt metacognitive thinking with a very specific phrase (e.g., fill in the blank statements; Stanton et al., 2015), we tried to apply this classification framework to student's free-written essays. Yes, we asked students about their learning and their goals, but we did not try to explicitly prompt a certain format of response. As such, our coding strategy needed to accommodate the fact that thinking is fluid, and students are constantly moving from metacognitive knowledge to metacognitive regulation and vice versa. No statement containing a whole thought stayed within the parameters of the theoretical framework available in the literature. Rather than simply try to make everything fit a specific subcategory (e.g., declarative), we allowed the categories to remain broad and instead tried to make a judgment call on the depth of reflection. Like Stanton et al. (2015), we rated their statements as better or worse depending on whether they: (a) provided an opinion on why something worked, and (b) provided evidence to back up their reasoning. Explicit statements about a learning strategy included opinions regarding why the strategy was being employed with supporting evidence. Meanwhile, vague statements labelled a strategy without any elaboration. Generally, explicit statements included more of the categorical elements and our interpretation is that more explicit statements are a more developed level of metacognitive knowledge.

Table 3
Coding Scheme for Evidence of Metacognition in Students' LPs

Theme	Description	Example Quote*
Metacognition	Any evidence in the text where a student is thinking about their own thinking or learning strategies, including poor thinking.	
I. Metacognitive knowledge	Includes awareness of cognitive processes (thinking) and the self as a learner (learning): conceptual understanding, knowledge of one's skills and best strategies as well as when to implement them, knowledge about learning tasks. Includes awareness of conceptual understanding and awareness of learning strategies that may be employed, and under what conditions they should be employed. Include a learner's understanding of what they do and do not know.	
A. Awareness of conceptual understanding	Ability to differentiate between concepts one does or does not know. Includes declarative statements about what a student learnt. Direct responses to the question "what did you learn?" Not to be confused with monitoring one's understanding. There is no action step here, just an awareness.	As we near the end of the semester I've developed a comprehensive view of how chemistry occurs in the biological sense and provides a more real-life view on what is being discussed in class. – 1267
B. Awareness of learning strategy	Ability to understand one's available learning strategies and when to use them. Traditionally this is conditional knowledge. Once strategizing and planning occur using this information it becomes regulation.	

1. Explicit statement	The student demonstrates an awareness that they use a learning strategy, but they also give a reason for why the strategy works (or not) and a supporting example.	Colour coding my drawings is another way that I help myself visualize the different facets of each system (e.g., following e- transport with blue, but using pink for protons). Using colour in this way helps to organize all the moving parts involved during complicated biochemical systems. I also just love drawing and colouring, so it is a fun and relaxing way to learn! – 124594
2. Vague statement	The student states they used a learning strategy without any opinion on efficacy or supporting example.	I typically read the textbook, underlining and jotting down points of interest right in the text. – 09468
II. Metacognitive regulation	Student shows evidence of activities that control their thinking and learning.	
A. Monitoring+ evaluating	Monitoring+evaluating includes evidence of active judgment/assessment of conceptual understanding, learning outcomes, or learning strategy. Students can either judge their understanding of a specific concept, or they can judge their performance on an exam as a proxy measure for their overall understanding of the material. Students can also judge the strategies that they used to learn.	
1. Comprehension	Includes statements that focused on conceptual understanding	When I first got my midterm mark back I was surprised, but I understood why I did poorly on the test. I had a decent understanding of the different amino acids, proteins, and reaction mechanisms, but I had trouble in certain areas when faced with the more hypothetical questions. I certainly had a fair grasp on the basics, but I was struggling to apply this knowledge further into application questions. – 105963
2. Learning strategy	Includes statements that focused on learning strategies	Usually I am more of a "crunching" type of studier, reviewing for long periods of time on a less often schedule. I have found fairly good success using this method for the short-term recall associated with tests, however it limits my long-term recall markedly. – 8679

B. Planning	Evidence that a student chose a learning strategy and allocated resources towards the use of this strategy. Included statements in which a student was planning to use a new strategy or alter an existing strategy before the final exam. Evidence that a student used their monitoring+evaluation to adjust their learning strategies, usually involved some statement on how they chose to use a new strategy after the first draft of their LP or after their midterm results. Evidence of planning was usually found in their response to the prompt: "If you were going to learn this again, how would you learn it differently or learn it better?" Keywords: plan, changed	
1. Abstract	Because there was a question that acted as a prompt for metacognitive planning, some students only answered the prompt in the future tense and did not make plans to implement changes between the midterm and final.	If I were to go back and change one thing about this semester it would be to set aside half an hour each day just to go through each of my classes and review key points, trying to better summarize them each day. – 105426
2. Concrete	These students discussed plans they enacted between the midterm and final to improve their learning outcomes. They moved beyond the prompt.	I have had to drastically change my learning habits following the midterm in order to make sure I am addressing course content on a daily basis in order to better understand things as a whole. – 128025

*Example quotes provided are for the final tier of the coding theme. The prior tiers are encapsulated in the example for the final tier.

Learning philosophy assignments were also coded for evidence of metacognitive regulation which included monitoring, evaluating and planning. Based on how students expressed themselves, monitoring and evaluating were coded as one category (called monitoring+evaluation). Monitoring is a prerequisite for evaluation, and statements of appraisal were usually linked with monitoring statements. For example, a student might acknowledge that they did poorly on the exam because they could not complete the application questions (monitoring); therefore, they decide that their current study strategy is inadequate because it does not include any application practice (evaluation). In addition, because evaluation requires monitoring, evaluation can itself be considered evidence of a student's monitoring ability, even if the student failed to explicitly articulate the first step. Students can monitor and evaluate both their conceptual understanding and their learning strategies; therefore, monitoring was subdivided to reflect the distinction (i.e., monitoring+evaluating comprehension vs. monitoring+evaluating learning strategy). Metacognitive knowledge of conceptual understanding should not be confused with monitoring+evaluating comprehension. When a student is simply aware of a concept, it was coded as metacognitive knowledge (e.g., I learnt about photosynthesis). When a student was actively judging their comprehension, it was coded as monitoring (e.g., I do not understand cellular biology as well as I should). Learning philosophy assignments were coded for evidence of planning, which in this case is using the knowledge from their monitoring and evaluation skills to inform their future plans to adjust their learning strategies. It became apparent that students planned in two distinct ways. Some students made concrete statements about plans that they were going to enact (or did enact) during the term while other students suggested ways that they could make changes should they ever be in a position to do so (coded as abstract planning).

Learning philosophy assignments were also coded for mastery and performance goals (Table 4). However, several other goals became apparent: career goals, civic learning goals, and personal growth goals. Career goals were defined as any mention of a specific job goal. Civic learning goals were defined as goals geared towards handling world problems and goals embedded in relation to city/country/community. For example, students who cited wanting to help people were often included in this category. Personal growth goals were defined as goals focused on learning to become a better person. They included frequent comments about life-long learning, developing wisdom and/or gaining knowledge, as well as learning to make better decisions.

Table 4
Coding Scheme for Indications of Achievement Goals in Students' LPs

Theme	Description	Quote
Performance	Any reference to concern over grades, GPA, marks, doing well on an exam, etc. Any reference to the need to pass, hand in, or complete material. Keywords: GPA, grades, marks, pass	The major motivator for me this term has been the actual mark. – 06308
Mastery	References to mastering content. Included discussions of seeking challenging tasks or striving under demanding situations. Their goals are directly related to the material. Keywords: understand, mastery	I have learned from the midterm that I need to understand the information rather than memorization. – 03275
Career	A direct reference to a future job.	I am taking the classes I need at Augustana in order to become a teacher. – 09302
Civic learning	Learning goals geared toward handling world problems. Also, goals embedded in relation to city/country/community.	The world has a lot of problems, one day I hope to have enough knowledge to solve a few of them. – 14296
Personal growth	Learning to become a better person. Goals were divorced from the material being learnt. Keywords: developing wisdom, increasing knowledge, life-long learning, making good decisions, making parents proud, and serving God.	I feel that individuals have an obligation, to themselves and to society, to take advantage of learning opportunities in order to maximize personal growth. – 115518

Results

Our analysis of students' LPs indicates that the assignment was effective in documenting students' metacognition. Regardless of year-level or achievement level, 100% of students showed evidence of metacognition (Table 5). Additionally, most students showed evidence of both metacognitive knowledge and regulation in their LPs. For example, one student exhibited metacognitive knowledge when he recognized that "[r]eading the textbook is definitely my favourite way to study." He then displayed metacognitive regulation when he acknowledged that "[m]y only complaint with this method is that it is very time consuming, there's so much information and it takes a long time to cover it all" (#106084). First, he displays knowledge of his actual learning strategy (reading the textbook), then he makes an evaluation of that strategy (time-consuming).

As expected, we generally found that more students exhibited metacognitive knowledge about their learning strategies rather than their comprehension (Table 5). This pattern holds across year-level and achievement level. When focused on comprehension, a student might identify that: "The concept that I remembered the best was the cell division and the different phases of the cell cycle because I thought that this concept was the most interesting" (#2398). Most students, however, expressed knowledge about their learning strategies. For example: "I personally prefer to write out notes because it helps me focus on the material I'm reading, and it gives me a chance to interpret the material" (#105963).

This same pattern was apparent for student expressions of metacognitive regulation; students were far more likely to monitor their learning strategies than their comprehension (Table 5). One student focused on comprehension confessed:

> For my first midterm for Biochemistry I performed very poorly on it. The main reason that I didn't do well on it was because I didn't understand the concepts. Even though I knew the definitions and the way cycles worked, I did not fully understand the biochemistry behind it. (#9899)

Meanwhile, most students focused on monitoring learning strategies. For example:

> I recognize that my grade is a good indicator of what I need to change in my learning strategy and exam preparations in order to make my strategy more effective. For the final exam preparations, I will be continuing with my current learning strategy because I find that rewriting notes, self-quizzing and drawing out diagrams are very effective ways for me to memorize the material, however I need to incorporate more applications outside of the classroom. The reason for this is because I found myself struggling the most with the application questions on the exam. (#72167)

Once again, this pattern was consistent across year-level and achievement-level.

We identified only two patterns of metacognitive thought that changed based on academic achievement level. First, low-achieving students were more likely to make abstract plans for their learning (Table 5). This pattern existed in all year levels. One student making an abstract plan said, "I feel like if I was learning this again, I should probably open the textbook" (#3246). Concrete plans did not increase with achievement but instead remained constant. For example, this student articulates a concrete plan:

> [O]ne technique that I will be sure to implement while studying for the final is to write questions that will allow me to apply the information from several articles to an over-arching theme, then answering them to the best of my ability. (#5670)

The second pattern occurred only in the 200-level cohort which displayed an increased ability to explicitly identify their learning strategies as achievement level increased (Table 5). A vague statement came with no elaboration, for example: "[f]or the midterm I used flashcards and watched videos and mainly just did my study visually" (#10346). Whereas an explicit statement included an explanation of why the strategy worked, often with an example.

Table 5
Percentage of Students who Showed Evidence in their Learning Philosophy of Metacognition and Goal Orientation by Course Level and Academic Level.

	Percentage of Students											
	100-level				200-level				400-level			
Category	Low (*n*=21)	Mid-Low (*n*=22)	Mid-High (*n*=23)	High (*n*=23)	Low (*n*=9)	Mid-Low (*n*=11)	Mid-High (*n*=9)	High (*n*=13)	Low (*n*=3)	Mid-Low (*n*=9)	Mid-High (*n*=7)	High (*n*=9)
Metacognition	100	100	100	100	100	100	100	100	100	100	100	100
Knowledge	95	91	96	96	67	100	100	100	100	89	86	89
Conceptual Understanding	33	41	39	22	11	18	11	15	33	22	14	22
Learning Strategy	90	86	91	87	67	100	100	100	67	78	86	89
Explicit Statement	76	55	78	78	44	64	89	100	67	67	43	67
Vague Statement	48	59	52	39	44	73	67	54	67	67	86	56
Regulation	100	95	96	100	89	91	100	100	100	89	100	89
Monitoring Comprehension	38	36	39	52	56	64	78	38	33	33	57	56
Monitoring Learning Strat.	81	73	83	96	78	82	100	85	100	56	86	78
Concrete Planning	57	36	57	61	56	73	78	69	67	67	57	44
Abstract Planning	43	32	30	17	33	18	11	0	67	11	14	11
Achievement Goal	90	100	96	100	100	100	100	100	100	89	100	100
Performance Goal	42	73	7	65	67	91	78	92	67	67	57	67
Mastery Goal	24	27	48	48	33	36	22	38	33	56	71	56
Career Goal	71	64	78	74	56	64	89	69	100	56	57	56
Civic Learning Goal	14	9	4	30	22	36	11	46	100	22	14	33
Personal Growth Goal	5	27	43	39	56	36	22	38	100	22	71	67

> I use self-testing a lot when I am preparing for a test. Usually I give myself a topic and I write down everything I know about it. When I do this, I find that I will hesitate writing down the things that I don't understand. Nonetheless, I will write down what I think the right answer is and continue until I have exhausted my knowledge on the topic. Then I check my responses to see if they were correct. If they are, I explore any details I missed and make sure I understand what they mean. If they are incorrect, I try to reflect on how I came to the conclusion that I did and determine why it was wrong. Usually this involves clarifying details in the textbook or examining key figures used in the slideshows. I have found this aspect of my study strategy to be very useful and to be a good indicator of my preparedness for an upcoming exam. (#5529)

As intended, the LP was also effective in revealing students' learning goals. Almost all students expressed an achievement goal of some sort, however, not all students clearly articulated performance or mastery goals. Generally, more students expressed performance goals rather than mastery goals, although this pattern is not absolute. A focus on performance often included a discussion of grades and/or GPA. For example:

> The reason I spent time learning all of the material is because it is important that even if I am not that good at biology I at least try to get a good grade on the final and pass the class. (#104338)

In contrast, a focus on mastery usually included some discussion of the importance of understanding content. For instance, "[t]he main thing I want to accomplish through my learning is a deep understanding and ability to apply my learning outside of my education" (#5422). It was also not uncommon for students to express mastery and performance goals simultaneously; often in the same sentence: "While the major motivator for me this term has been the actual mark, I see the importance of developing a good base of information that can be used in higher level courses" (#06308).

We found evidence for three additional goals: career goals, civic learning goals, and personal growth goals. Career goals were more common than civic learning goals or personal growth goals. A student with a civic learning goal noted:

> By learning about a variety of concepts, I have come to know why certain events are happening in this world, the underlying issues of these events, and most importantly, what I can do to change it. I can help stop racism by providing evidence from my biology classes about all of us being very similar in our genetic makeup, with no evidence supporting that one race is superior over another. (#1675)

While a student with a personal growth goal said, "I learn so that I can make better and more informed decisions as I continue to live my life" (#3350). It was also common for students to simultaneously have multiple goals. For example, students expressed career goals tied to civic goals (e.g., wanting to help people and thus becoming a doctor). Students also commonly expressed career goals in conjunction with performance goals (e.g., I need a decent GPA to access further education to meet my career goal). We did not see any distinct patterns of goal orientation based on course-level or achievement level.

Discussion

Our goal in designing the LP was twofold: documenting students' metacognition and encouraging students to consider their learning goals. Our analysis confirms the LP was successful in recording metacognition. All students displayed metacognition regardless of course level or achievement level. In this respect, we follow in the footsteps of other researchers who have successfully prompted metacognition in the classroom (Colthorpe et al., 2017; Kurt & Kurt, 2017; Sabel et al., 2017). Additionally, most students exhibited both metacognitive knowledge and metacognitive regulation. Considering that metacognitive knowledge is a precursor for metacognitive regulation this result is not surprising (Ohtani & Hisasaka, 2018; Schraw & Moshman, 1995; Vrugt & Oort, 2008). We also found that students were more focused on their learning strategies than their conceptual understanding: this occurred for both metacognitive knowledge and regulation. This result was expected based on our own focus on learning strategies when creating the LP.

Despite the assumption that metacognition and academic achievement are related (de Boer et al., 2018; Dent & Koenka, 2016; Ohtani & Hisasaka, 2018), as well as the suggestion that metacognitive ability is reduced in low-achieving students (Händel & Fritzsche, 2016; Sebesta & Bray Speth, 2017), we saw few systematic changes in metacognition based on achievement level. One exception was that low-achieving students (regardless of year-level) were more likely to create abstract plans for their future learning rather than make concrete plans to change during the term. Our results are consistent with the work of Stanton et al. (2015) who studied metacognitive regulation in undergraduate biology students. They found that most students were willing to create new study plans (98.4%), but only half (51%) appeared able to enact these plans. They concluded that not all students can respond favorably to metacognitive prompts. In our case, it appears that lower-achieving students were not as responsive to instructors' feedback. Students were asked: "If you were going to learn this again, how would you learn it differently or learn it better?" (Haave et al., 2018). Low-achieving students responded to the prompt(s) (e.g., this is what I would do if I could take the course again) while high-achieving students made the leap from reflecting on the page to making concrete changes to their learning strategies (e.g., I have decided to use this learning strategy to help me prepare for the final). Stanton et al. (2015) suggest a continuum of developmental stages for metacognitive regulation in undergraduate students: "not engaging," "struggling," "emerging," and "developing" (p. 8). Students may move through a continuum in which they are 1) unwilling to reflect and adjust their learning, 2) willing but unable, 3) willing but lack follow through, and 4) both willing and able to reflect on and adjust their learning. They noted that students in the struggling category used non-committal language when discussing plans to enact new learning strategies (e.g., might, try). Parallels can be drawn between our definition of an abstract plan and Stanton et al.'s (2015) understanding of non-committal language; they both earmark a plan for a new strategy but do not explicitly show evidence that they decided to use it (e.g., If I were taking this course again I would…, I might…, I could try…). Therefore, it is possible that our lower achieving students are struggling with their metacognitive regulation skills as envisioned by Stanton et al. (2015). This remains consistent with research suggesting low-achieving students have less developed metacognition; we would expect low-achieving students to be less capable of optimally responding to metacognitive prompts (Händel & Fritzsche, 2016; Sebesta & Bray Speth, 2017; Ziegler & Montplaisir, 2014).

The second exception, in 200-level students, was that high-achieving students showed an advanced level of metacognitive knowledge when they made explicit statements regarding their learning strategies. Although we coded all examples of metacognitive knowledge under a single category, metacognitive knowledge is often subdivided into declarative, procedural, and conditional knowledge (Jacobs & Paris, 1987). Therefore, statements about one's learning strategy could run the gamut of simply acknowledging what strategy you used, to explaining when and why you used it. High-achieving students were more capable of elaborating on why they thought a strategy was useful (or not) and often included an example of how they used the strategy. Although this pattern was only apparent in 200-level students, it does align with the suggestion that higher-achieving students will have a greater capacity for metacognition (Händel & Fritzsche, 2016; Sebesta & Bray Speth, 2017; Ziegler & Montplaisir, 2014).

Our LP was also successful in encouraging students to consider their learning goals. Most students displayed evidence of learning goals regardless of course-level or achievement level. We found a great diversity of goals outside the goal orientation framework. Many students cited career, civic learning, and personal growth goals as their main motivation to learn. Many students were capable of describing their performance or mastery goal orientation; of those that did, most students endorsed performance goals. It is possible that students' emphasis on performance goals is simply a result of the educational context. Post-secondary students are aware of the necessity of a high GPA for further educational opportunities. We also found many students simultaneously held multiple achievement goals. This phenomenon can be understood in two ways. First, some students may have been attempting to articulate both a task-specific goal (e.g., the desired outcome for the current task) as well as a superordinate goal orientation (e.g., the motivation behind the task) (Pintrich, 2000b). For example, many students who looked at their degree as a task may have considered a career outcome as a task-specific goal, but still discussed their love of biology as the reason they chose that career (mastery orientation). Second, many students simultaneously held both performance and mastery goals. This coincides with existing research on multiple goal perspective, suggesting that the traditional dichotomy between mastery and performance goals has been overstated, and students can simultaneously claim differing levels of both goals (Pintrich, 2000a; Vrugt & Oort, 2008). For example, Pintrich (2000a) found that students with a combination of high-mastery/high-performance orientation were able to avoid the expected maladaptive cognitive-affective-behavioural patterns that are traditionally associated with performance orientations.

Limitations of our research suggest new avenues for future study. The LP was designed as an educational tool, not a measure of metacognition or goal orientation. Therefore, our results do not always reflect the correlations suggested in the literature (e.g., metacognition and academic achievement), and we saw few systematic differences between low- and high-achieving students. Our purpose was to help students practice their metacognitive skills and begin to recognize their greater learning objectives. To that end, we have been successful. However, researchers who are interested in further studying metacognition as a construct might consider employing both an educational tool like the LP alongside a more stringent measure of metacognition. The LP relied on self-reported metacognition off-line (i.e., after a task has occurred) and it has been suggested that offline measures reduce the correlation between metacognition and academic achievement (Dent & Koenka, 2016; Ohtani & Hisasaka, 2018). An on-line measure (i.e., during the task) may better support the correlations between metacognition and academic achievement, but it is unlikely to provide any additional educational support to students. Whether educators feel the need to further support the link between metacognition, goal orientation, and academic achievement in the classroom is another matter.

The theoretical framework that suggests metacognition can be discretely split into the subcategories metacognitive knowledge and metacognitive regulation is problematic. To be effective, a classification system must be exhaustive and mutually exclusive. New interpretations have blurred the boundaries between metacognitive knowledge and metacognitive regulation such that some textual examples can now be coded in both categories. Once we lose exclusivity, our categories are less effective. We found ourselves in the position of having to resolve conflicting definitions in the existing literature, and our own coding strategy does not strictly align with the theoretical categorization because of these conflicts. While we have attempted to clearly define the codebook within which we worked, it is possible that the existing framework for classifying metacognition is unsuited to classifying statements made by learners, in particular, learners who have not been explicitly taught about metacognition as a construct. Additionally, existing classification systems may not be ideal for coding metacognitive thinking in a free-writing format. It is much easier to apply a classification system if you restrict the format of potential responses.

There is the possibility of selection bias in those courses in which the LP was one possible assignment among many (i.e., the LP was not completed by all students). However, we have previously published (Haave et al., 2018) a start of term assessment of students' intellectual development and academic ability and found no initial differences between those student cohorts who completed the LP relative to those who did not. Anecdotally, it seemed that some students who experience exam anxiety may have chosen the LP in exchange for a lower weighting of the midterm and final exams. Additionally, some students in the study chose to complete the LP more than once. It is possible that this double exposure has created a practice effect. Students who completed the LP twice might show improved levels of metacognition.

Another limitation of this study is that coding was done by one coder due to limited resources. However, coding was discussed between the primary investigator and research assistant through the coding process to promote accuracy. Consistency among classes was promoted by re-reading/recoding LPs between courses/terms.

We must also note that some models of goal orientation split performance goals into performance-approach and performance-avoidance goals (Ames, 1992; Elliot & Harackiewicz, 1996). It is possible that performance-approach goals are similar to mastery goals in creating positive cognitive-affective-behavioural patterns (Ames, 1992; Elliot & Harackiewicz, 1996). By coding performance goals as a single construct, we were unable to distinguish between these two potentially different orientations. Low-achieving students might carry more performance-avoidance goals. Educators would benefit from future studies that consider the qualitative nature of students' performance-approach and performance-avoidance goals so that we might better understand what these goals look like in differently achieving undergraduate students.

Conclusion

Our LP was successful in documenting metacognition and an awareness of learning goals in undergraduate biology students. Most students showed a combination of metacognitive knowledge and metacognitive regulation, reflecting the assumption that metacognitive knowledge is a necessary precursor to metacognitive regulation. Our results partially reflect the suggestion that low- and high-achieving students have different metacognitive capacities. Low achieving students were more likely to make abstract plans for their learning regardless of course-level, and in the 200-level cohort, high-achieving students were more explicit in articulating knowledge of their learning strategies. We found a great diversity in students' learning goals beyond simply a performance or mastery orientation. Students were focused on career, civic learning, and personal growth goals. In line with multiple goal perspective, it was not uncommon for students to hold both a mastery and performance goal. It is our hope that this research improves our understanding of what metacognition and goal orientation look like in undergraduate students. As educators, understanding how students perceive their own learning strategies and goals better positions us to effectively encourage self-regulated learning in our classrooms.

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