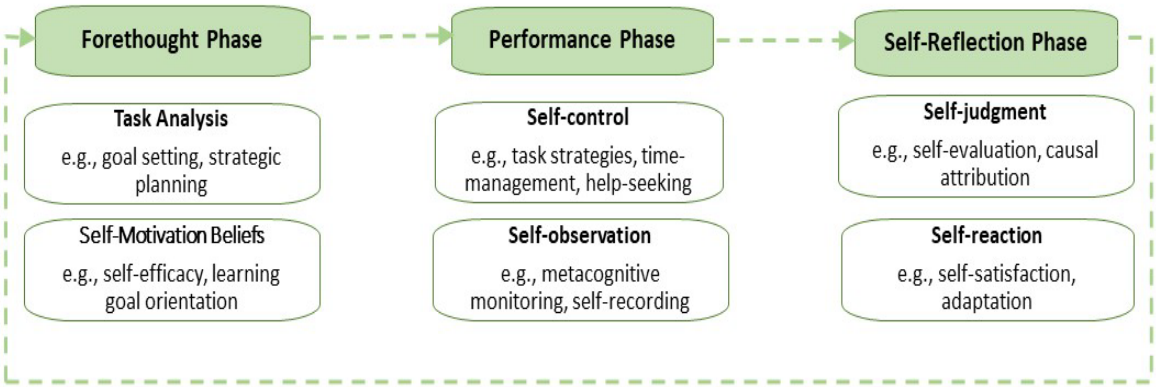
The second line of research builds on the theories of self-regulated learning (SRL) and metacognition. Theories of self-regulated learning suggest that students are active agents who direct and steer their learning process in pursuit of personal learning goals. Figure 3 illustrates the three cyclical phases of Zimmerman's SRL model adapted from Zimmerman and Moylan (2009) (for review of Zimmerman's SRL model, see Panadero, & Alonso-Tapia, 2014). Students typically set goals and make plans before embarking on a task. When working on a task, students will deploy various learning strategies and self-monitor their learning. At the end of the task, students will self-reflect on their learning process before repeating or adjusting their cycle of SRL. Research suggests that SRL is positively related to academic achievement. Therefore, the second line of research will employ the theories of SRL and metacognition to better understand how students learn, and ultimately, enhance performance and transfer of knowledge from mathematics to engineering.

Figure 3
Three cyclical phases and processes of self-regulated learning adapted from Zimmerman and Moylan (2009)



The main focus of the second line of research is on students' learning performance and transfer of knowledge from mathematics to engineering in PRIME. Currently, videos with contextual examples of mathematics in engineering are created. The intent of the videos is to support non-math students in their mathematics education by 1) making mathematical concepts more meaningful through the applied examples, 2) increasing engagement with mathematics education by relating to students' own field of interest, and 3) promoting a sense of autonomy by giving students the choice to watch the videos and manage their study pace. As shown in the Figure 4, Study 3 will be an empirical study to investigate the effectiveness of adding in-video prompts on student performance and transfer. We will examine two types of in-video prompts: 1) prompts with math problems in context to support self-testing and 2)

prompts to elicit self-explanation of the solution steps in the provided worked examples. Another study in this line of research is to investigate the study strategies that are frequently used by students to learn math (Study 4). Prior studies suggest that students are prone to use less effective strategies, such as cramming instead of spacing out their study, which can have negative effects on their performance. Therefore, the aim of Study 4 is to understand whether students are using effective study strategies and to examine the role of the study strategies on students' academic performance. Results of Study 4 will provide a basis for further studies (e.g., Study 5) in which we will develop and examine interventions to support students' autonomy during study and to enhance academic success in PRIME.

Figure 4

Summary of research questions in second line of research

Second Line of Research: Enhance Performance and Transfer

Study 3. Enhancing student performance and transfer using videos with contextual examples
Research Question: What is the effect of adding in-video prompts (i.e., practice questions vs. worked examples with self-explanation prompts) to contextual example videos on students' performance and transfer?

Study 4. How do students learn?
Research Question 1a : What are the study strategies that students most frequently use?
Research Question 1b : Are there differences in the reported study strategies between different groups of students?
Research Question 2 : What is the relationship between the reported study strategies and academic achievement?

Study 5. Interventions to enhance study strategies as a way to support autonomy
To design interventions (e.g., training, serious games, or learner analytics visualization) to enhance students' study strategies and facilitate better decision making.