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GIFTS: Metachron – A Structured Time Management and Reflection Activity for First-Year Engineering Students

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Introduction

Engineering education is characterized by high academic demands, intensive workloads, and cultural norms that at times equate stress with rigor and professional preparation. For first-year undergraduate engineering students, these expectations coincide with a significant developmental transition that includes adapting to new academic standards, forming a professional identity, and balancing coursework with personal and career responsibilities. Existing research consistently links first-year engineering experiences with combinations of elevated stress, fear of failure, perceived overload, imposter syndrome, and decreased motivation. These issues together negatively influence students' persistence and well-being [1]-[3].

Students frequently describe the combination of these challenges as a lack of time, reporting that they "do not have enough hours" to meet expectations. However, research on students' time use suggests that perceived time scarcity often reflects gaps in planning, monitoring, and reflection rather than absolute workload alone [1], [4]. From this perspective, time management is not merely a logistical skill but a metacognitive one, requiring intentional decision-making, awareness of priorities, and adaptation based on feedback. *Metacognition* is defined as the awareness and regulation of one's own thinking and learning processes [5], a crucial piece of Self-Directed Learning (SDL). SDL was defined by Knowles [6, p.18] as the "process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes." Developing students' SDL capacities, including goal setting, progress monitoring, evaluation, and behavioral adjustment, is therefore critical during the first year of engineering study [7], [8]. This need motivated the development of *Metachron*, a structured reflective time-logging activity designed to support students' metacognition, SDL, and professional awareness.

Theoretical Background and Frameworks

Metachron is grounded in theories of SDL and metacognition, which emphasize learners' need to plan, monitor, and evaluate their cognitive and behavioral strategies. SDL frameworks position learners as active agents responsible for setting goals, tracking progress, and adjusting behaviors in response to outcomes [7], [8]. In engineering education, the development of these skills is particularly important during the first year, when students must navigate complex schedules, competing priorities, and increasing autonomy [9]-[11].

Metacognition provides a complementary lens for understanding students' time-use challenges. Further, research indicates that structured reflection activities, iterative review, and personalized feedback can improve students' awareness of how their time is allocated and how those choices align with academic and professional goals [12]-[14]. In prior research, time management proficiency has been linked to both academic performance and student well-being, reinforcing the value of interventions that promote intentional planning and reflection [15]. Structured time management reflection guides, such as [16], similarly demonstrate that intentionally scaffolded prompts support deeper student metacognition and learning alignment. Tools such as timesheets and time-logging assignments, when paired with reflective prompts and feedback, have been shown to foster metacognitive insight rather than mere compliance [4], [12].

Metachron operationalizes these principles by combining structured time logging with guided reflection and coaching feedback. The goal of this activity is not precise measurement of time use, but the development of students' capacity to recognize trade-offs, challenge misperceptions, and make intentional decisions about how their time supports learning and professional growth.

Program Context

The need for implementing such an intervention such as Metachron emerged within the authors' context: Iron Range Engineering (IRE), an accelerated, professionally-integrated engineering program (detailed in [17]). Students enter the five semester program after completing approximately two years of general and STEM foundational coursework. The first semester, known as the Bell Academy, serves as an intensive transition period and students are expected to rapidly develop both their technical competencies and professional skills, including communication, teamwork, conflict management, career development, and SDL.

While these skills are essential for engineering practice, their integration alongside technical coursework substantially increases students' demands during the Bell Academy semester. Early instructional interventions at IRE focused on improving students' use of planning tools and schedules. Although these efforts increased tool adoption, students continued to report high levels of stress and persistent feelings of time scarcity. This disconnect prompted a central instructional question: *Are students accurately perceiving how they allocate their time, and can structured reflection improve their time management skills and awareness in meaningful ways?*

Rather than further increasing prescriptive instruction or reducing academic expectations, Metachron was designed to support students in developing metacognitive insight into their own time use. By reframing time logging as a reflective and developmental activity rather than a compliance task, Metachron creates space for sense-making, coaching conversations, and alignment between students' stated priorities and enacted behaviors.

Implementation

The Metachron is a required, modular, and reflective time-tracking activity designed to help engineering students develop increased awareness of how they allocate time, align activities with professional and academic priorities, and strengthen habits of SDL. A graphic representation of the entire project is provided in Appendix A. The activity is iterated twice per semester as a structured cycle of observation, analysis, and reflection.

Around Week 5, when coursework has stabilized and students begin to intensify their co-op search, the first Metachron cycle is introduced. One faculty member and one learning coach jointly facilitate a ~45-minute workshop providing context, instructions, and examples. Students record daily allotted hours in decimal form (00.00) across four categories:

- **Technical coursework** – lecture, lab, and homework.
- **Design project work** – team-based or individual design projects.
- **Career development work** – résumés, interviews, career fairs, and job search.

- **Seminars, SDL, and workshop activities** – professional development learning.

Students log hours daily using a standardized form, with reminders for complete submissions. Faculty compile individual and cohort data, calculate summary statistics, and prepare personalized feedback charts. The facilitation team then emails individualized feedback and recommendations (e.g., increasing career development time if underrepresented) and hosts a 15-20 minute workshop to review outcomes and spend time reflecting as a group.

After logging their time and attending the short workshop, students complete a written reflection on the exercise's value, the accuracy of tracking, alignment of time use with priorities, and planned adjustments (Appendix B). A second cycle occurs later in the semester, following the same structure but requiring less instructional support. Another brief workshop presents updated data, allowing students to compare cycles and assess progress. A second reflection invites students to consider changes made, insights gained, and strategies for the future (Appendix C).

Cohort results (typically 20–40 students) are reviewed by the faculty and staff collectively to highlight trends and outliers, such as disproportionate technical work or limited career development. Reflections are formative and graded only for completion, supporting continuous improvement in self-regulation and similar professional competencies.

Metachron's design is flexible, modular, and transferable. While developed for first-year engineering students, it can be adapted for co-op transitions, senior design, or other intensive experiences which would benefit from providing students a reflective time-management activity. Categories, timing, or prompts may be modified to fit program priorities. Programs may implement a single cycle, integrate it into existing advising, or use aggregate data to inform curricular improvements. Using common digital tools and minimal class time, this tool can be replicated across institutions to enhance time management, metacognitive reflection, and professional readiness.

Assessment

Assessment of the Metachron activity focuses on activity leaders providing formative feedback that encourages student reflection, rather than research analysis or high-stakes grading. To incentivize complete responses, students are required to submit both their time logs and written reflections for full participation credit. Students are explicitly informed that no judgment or evaluation is associated with how time is reported; accuracy and honesty are emphasized to support reflection rather than comparison or surveillance. Submissions are reviewed for completeness and thoughtfulness, with faculty and staff providing individualized feedback.

After students' week-long submissions are complete, instructors generate summary statistics of the data at both the individual student and cohort levels to support: (a) individual reflection on time allocation and priority alignment, (b) contextualizing workload relative to peers, and (c) faculty and administrator consideration of approximate student workloads. To support (a), each student receives a personalized chart showing time distribution across four categories—technical coursework, design project work, career development, and seminars/SDL. Cohort-level summaries are then shared to support (b). Faculty and staff review cohort-level patterns to inform coaching discussions, workshop content, and program-level time-management support.

To further support reflection and contextual understanding (a and b), a learning coach and a faculty member jointly review students' written reflections and facilitate workshop discussions following each Metachron cycle. These artifacts consistently indicate increased awareness of time allocation, clearer recognition of competing academic, professional, and personal priorities, and emerging strategies for reallocating time in alignment with stated goals. Students frequently describe the activity as eye-opening or validating, particularly when comparing their own patterns to cohort-level summaries. Some students report that daily time tracking is burdensome, consistent with prior work [4], who found that first-year engineering students valued time-logging assignments for reflection despite perceiving the process as effortful.

Taken together, this assessment approach integrates reflective writing and guided discussion to promote metacognitive development and time-management awareness. The process is used as an instructional tool rather than for research or evaluation, supporting both students and the program in understanding and improving the distribution of time and effort across technical and professional competencies.

Limitations and Future Work

The Metachron activity provides students an opportunity, as part of their coursework, to reflect on their time management, discuss improvement strategies with experts, and assess the outcomes of initial changes. Accordingly, Metachron should be understood not as a time-use measurement instrument, but as a reflective pedagogical tool intended to surface perceptions, priorities, and decision-making processes. Several limitations exist, particularly regarding use of the activity for broader purposes. Most notably, Metachron has limited value as an accurate measure of student time use, as follow-on discussions often reveal over- and under-estimation of time spent relative to recorded values. Practitioners are therefore encouraged to focus on the meaning behind students' perceptions of time use, treat the activity as reflective rather than referential, and use workshops and follow-up discussions to refine students' goals and subsequent behaviours.

Additionally, time spent on similar activities varies substantially across individuals, and a fixed amount of time does not yield equivalent outcomes for different students [18]. As a result, cohort-level analyses should be interpreted cautiously. Practitioners should discuss aggregated results with students before making program-level changes, and students should be encouraged to recognize the uncertainty inherent in cohort-level values.

Addressing these limitations requires additional work. Future efforts will focus on better understanding students' perceptions of the Metachron activity through a mixed-methods study examining students' interpretations, perceived usefulness, and engagement over longer time scales. A second area of future work is improving the validity and reliability of survey instruments used to estimate time spent across activity categories. While perceptual data remain valuable, more accurate estimates would better support institutional recommendations and enable more targeted time-management discussions.

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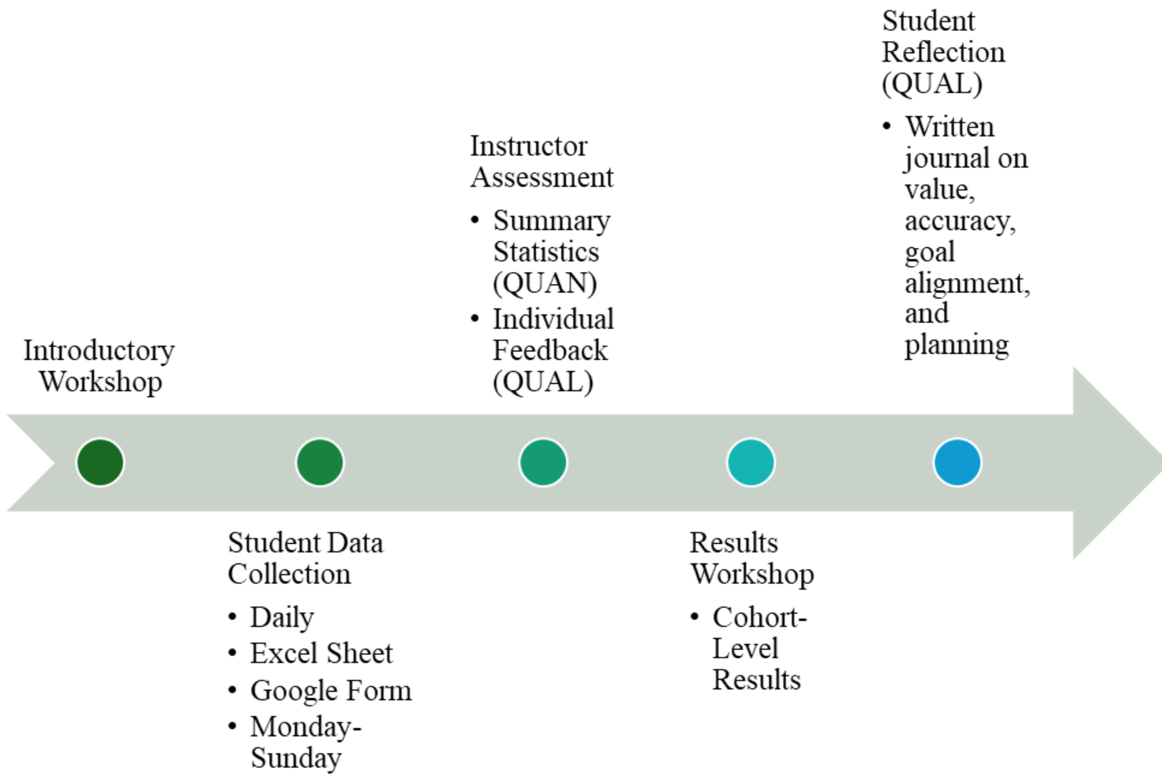
Appendices

Appendix A: The Metachron Timeline



Appendix B: First Metachron Reflection Prompts (Round 1)

Purpose: The first reflection helps students interpret their initial Metachron data and begin connecting observed time use to priorities, values, and self-management habits. Reflections are submitted in paragraph form through Google Classroom.

Instructions: Reflecting in writing is an important part of truly understanding and remembering what you've learned. This short journal entry will help you process your learning and experiences.
We're looking for thoughtful responses to the prompts—about 2–3 sentences per prompt. This assignment should take around 15 minutes to complete.
Acceptable AI Usage for this Assignment: None

Prompts:

1) Did you anticipate this exercise being valuable? Reflecting honestly on your Metachron results, how well do you feel you kept track of your time over the Metachron week?
2) What do you find most interesting about your Metachron results, and what do the results say about how you spend your time?
3) How well do you feel your Metachron results reflect your priorities? What adjustments do you feel you should make?

4) How will you use the results of the Metachron analysis to improve your future time utilization? How can you improve your implementation of the Metachron to provide you with more useful data in the future?

Faculty provide individualized feedback based on student reflections and time logs, using both to reinforce metacognitive awareness and realistic goal setting.

Appendix B: Second Metachron Reflection Prompts (Round 2)

Purpose: The second reflection guides students in evaluating their progress, comparing changes since the first cycle, and articulating ongoing strategies for managing time and priorities. This short reflection is completed following the second workshop.

Prompts:

1. Comparing your first and second Metachron results, what changes do you observe in how you allocated your time?
2. Which adjustments from the first round were most successful? Which areas still need improvement?
3. How have your priorities shifted since the start of the semester?
4. What insights or habits will you carry forward to future semesters or professional settings?
5. What advice would you give to future students completing Metachron for the first time?

Students discuss aggregate class results during the follow-up workshop and use the reflection to set personalized goals for continued growth in time management and SDL.

Appendix C: Table Summary of Metachron Project Implementation

Component	**Description**
Purpose	To help first-year engineering students develop awareness of time use, align activities with academic and professional priorities, and strengthen habits of SDL.
Implementation Timing	Two cycles per semester: first in Week 5 (after workload stabilizes), second near the end of term.
Facilitators	One faculty member and one learning coach jointly deliver workshops and feedback.

Workshop Format	Cycle 1: 40-minute introduction with examples and instructions. Cycle 2: 10–15 minute check-in and data review.
Time Categories Tracked	1. Technical course work 2. Design project work 3. Career development (résumés, interviews, fairs, job search) 4. Seminars, SDL, workshops, related activities
Student Tasks	Record daily hours (in decimals) for one week using Google Classroom form; complete written reflection (Appendix B or C).
Faculty Tasks	Compile data using Google Sheets and Excel; prepare summary statistics, individual vs. cohort charts, and narrative feedback.
Feedback and Reflection	Individual feedback emailed; cohort results discussed in follow-up workshop. Students complete written reflections after each cycle.
Cohort Size	Typically 20–40 students.
Assessment Use	Submissions required for credit. Data and reflections used for formative feedback and coaching; not for research or grading.
Adaptability	Framework is modular—can be run once, embedded in advising or career development courses, or scaled to other programs.