Exploring the Self in Engineering Education: The Design of a Self-Reflective Workshop Series to Position Students for Self-Regulation

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Introduction

The development of students as lifelong learners has become a widely accepted goal for institutions of higher education. For a number of years within engineering education, engineering accreditation boards in the US, Canada, and internationally, have recognized lifelong learning as one of the key competencies of engineering graduates. Characteristics of the lifelong learner include the ability to “set goals, apply appropriate knowledge and skills, engage in self-direction and self-evaluation, locate required information, and adapt their learning strategies to different conditions” (p. 292-293)\(^1\).\(^2\) Inherent in these skills of lifelong learning is the ability for one to be a self-regulated learner with the ability to plan, monitor, control, and adjust his or her behaviour to achieve a desired outcome. In a learning context, self-regulation is highly integrated with goal setting, metacognition, and motivational theories \(^3\), and when applied effectively, can be a positive contributing element to students’ academic achievement and persistence. As engineering educators develop pedagogies for lifelong learning skills development and assessment, the aim of this work is to support students in positioning themselves for self-regulated lifelong learning.

Our study is an investigation into students’ sense of self as the launching point for self-regulating behaviour. A number of works have identified the relationships between the self and the process of self-regulation\(^4\).\(^5\).\(^6\).\(^7\). Self-awareness, involving the process of turning one’s attention inward towards oneself, has been argued as the first step to self-regulation\(^4\).\(^6\). Furthermore, there is an inherent connection between the self, motivational theories, and personal fulfillment. Ryan\(^8\) identified the role of the self in intrinsic motivation, emphasizing that “the more fully one adopts a social value or prescription, the more it is identified with the self, and the more it is performed or acted on with a sense of autonomy and personal commitment” (p. 216).

Through this work, we propose a pedagogical approach that would add value to students’ learning experiences through reflective self-discovery, as well as offer a research opportunity to investigate students’ sense of self and inform teaching practice. Our pedagogical approach and research method consists of a two-part series of workshops designed as a professional development opportunity. The workshops will be offered to all undergraduate engineering students at one medium size university. In the workshops, participants will engage in facilitated guided reflection exercises designed to elicit their thoughts and descriptions about who they are and their purpose in their engineering studies. Participants will be asked to write a personal statement on how they see themselves in their studies and how they envision the person they wish to become in their future career.
This paper presents the work in progress of this research study, highlighting the research approach, methods, and design. Future plans for research are discussed.

Background

According to Engineers Canada⁹, the graduate attribute of lifelong learning is defined as “[students’] ability to identify and to address their own educational needs [emphasis added] in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge” (p. 14). Within our interpretation of this definition and drawing attention to students’ ability to address “their own educational needs”, we posit that it is important for students to develop their personal sense of self and their own personal aspirations. From a curriculum perspective, a humanistic curriculum¹⁰ orientation focuses on the element of personal development in one’s curriculum through intrinsically rewarding experiences. A number of authors have pointed to the need for students to develop a personal sense of self in higher education. Mezirow¹¹ called for transformational learning that involves “how we learn to negotiate and act on our own purposes, values, feelings, and meanings rather than those we have uncritically assimilated from others” (p. 8). First proposed by Kegan¹², Baxter Magolda¹³,¹⁴ has published extensively on self-authorship, defined as “the capacity to internally define [one’s] beliefs, identity, and relationships” (p. xvi). In an engineering education context, Sattler, Turns, & Mobrand¹⁵ demonstrated the utility and significance of a self-authorship framework to interpret and assess engineering student preparedness portfolios.

As engineering educators work towards creating transformational learning experiences that support a humanistic curriculum orientation, a number of challenges lay ahead: How can educators support engineering students in their development as intrinsically motivated, self-directed learners? As new pedagogy and assessment for lifelong learning competencies are developed, in what ways might students be developing or demonstrating related competencies that may not yet be considered? How might educators help students self-monitor their progress and performance of lifelong learning competencies throughout their engineering studies?

To address these challenges, we are interested in ways to support students in finding personal meaning in their engineering studies so they act with agency and purpose in their learning⁴,¹⁶. For our work, the learning situation is conceptualized as the totality of experiences involved in completing an undergraduate degree in engineering as guided by the institution. We intend to challenge students to think about who they are and what they are doing in their engineering studies irrespective of any specific subject knowledge domain. Our approach to lifelong learning development begins with students’ introspection and recognition of themselves as partners in education. Our goal is for students to appreciate themselves as agents in the learning process—as active participants with the responsibility for their learning and the volition to direct their own learning activities.
Research Purpose and Questions

This research serves as a learning opportunity for students’ to explore their self-knowledge, and as a research opportunity to investigate how this self-reflective thinking may influence students’ ability for lifelong learning. We approach our investigation with consideration to two underlying social cognitive processes attributed to lifelong learning skills: metacognition and self-regulation.

While learning strategies and pedagogical applications may engage students in metacognition and self-regulation for achievement in a course setting, we intend to engage students in metacognitive thinking about their overall learning, educational experience and curriculum. We strive to engage students in reflective thinking about their past, present, and future, to support students in positioning themselves for success in their undergraduate programs and future careers.

This research holds two primary purposes:

1) As a professional development opportunity to engage students in a self-discovery process where they are challenged to consider their agency, purpose, and sense of self in their engineering education.

2) As a qualitative exploratory investigation into the way students formulate and articulate their position in engineering education and possible selves for their future career.

Based on these objectives, the following two research questions guided the study:

**Research Question 1:** How are students engaging in the experience/process of reflection and metacognition directed towards their personal curriculum and learning experiences?

**Research Question 2:** How does this engagement contribute to the development of students' ability for lifelong learning?

To explore these research questions, a two part workshop program was designed to engage students in a series of guided self-reflection exercises and peer discussion about themselves and their engineering education. Students’ reflections from the workshop participation will be captured as research data to qualitatively investigate elements of students’ sense of self and its implications for self-regulation. The study is currently in progress at one mid-size university and all undergraduate engineering students from all years and all disciplines will be invited to participate. The following section will describe the background theory supporting the workshop design.
Workshop Design

Due to the nature of the workshops as the primary data collection site, the workshops did not have specific instructional learning outcomes to avoid participant bias and external influences. However, the following overall workshop objectives are provided as a guiding framework:

By engaging students in an exploratory self-reflective process, the workshops serve to:

1. Engage students in reflective thinking about:
   - their past experiences
   - their current position in engineering education
   - their future in engineering professional practice
2. Support students in articulating how they position themselves for their engineering studies and future careers through a written personal statement
3. Foster in students a sense of lifelong learning with the skills of reflection and self-directedness

This research is focused on the role of the self in student’s self-regulated learning. Self-regulated learners are characterized by their ability to be metacognitively, motivationally, and behaviourally active participants in their own learning processes\textsuperscript{17}. Carver & Scheier\textsuperscript{4} described self-regulation as an active process that involves self-corrective adjustments in one’s behaviour and a sense of purpose with respect to one’s goals and values. In the same way, Baumeister\textsuperscript{6} viewed self-regulation as “the self’s capacity to alter and change itself and its states, particularly so as to bring them into line with standards such as norms, goals, ideals, or rules” (p. 158).

The role of the self in motivation and self-regulation has been extensively discussed in previous work\textsuperscript{5,17,18}. In this research, we consider the role of students’ current selves and possible selves\textsuperscript{19} on motivation and self-regulation. As a form of self-knowledge, possible selves “represent individuals’ ideas of what they might become, what they would like to become, and what they are afraid of becoming” (p. 954)\textsuperscript{19}. When we speak of “the self”, we are referring to the representations, descriptions, and schema of students’ self-knowledge that exists in their mind\textsuperscript{4}. In this way, “the self” becomes the subject of inquiry\textsuperscript{20,21} for participants in the workshop, as well as the mechanism through which educators may develop students’ ability for self-regulation. The workshop activities intentionally challenge participants to explore “the self” within their own contexts, while serving as data collection methods of participants’ sense of self. By qualitatively exploring what exists in participants’ self-knowledge structures of current and possible selves, we believe students will be positioned to identify and evaluate their motivational beliefs (ie. expectancy and values), goal setting, and self-standards for behavioural comparison.
For the purpose of our research, we have structured our exploration into students’ sense of self around three conceptual social cognitive areas to account for the interplay between personal, behavioural and environmental elements in self-regulation\textsuperscript{16,17,22,23}: 1) students’ sense of agency, 2) students’ sense of purpose, and 3) students’ sense of self-knowledge. These conceptual areas were operationalized to form the framework of our investigation and workshop design (Table 1).

The workshop exercises were designed to engage students along the three self-regulatory phases of forethought, performance, and self-reflection\textsuperscript{24}, while operationally integrating cognitive, affective, motivational, metacognitive, and behavioural dimensions of the self\textsuperscript{25,26} (Table 2). Additionally, to target students’ metacognitive abilities, the reflective exercises are based on three sub-processes of self-regulation: self-observation, self-judgement, and self-reactions\textsuperscript{22,24}.

<table>
<thead>
<tr>
<th>Conceptual research area</th>
<th>Operational definition</th>
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<tbody>
<tr>
<td>Sense of agency</td>
<td>Students’ ability to take responsibility for their learning and to exercise volition in directing their learning activities based on their sense of purpose</td>
</tr>
<tr>
<td>Sense of purpose</td>
<td>Students’ motivational values and personal beliefs about themselves in their engineering education and future career</td>
</tr>
<tr>
<td>Sense of self-knowledge</td>
<td>Students’ personal characteristics, qualities, and standards derived from their self-reflection, experiences, interaction with others and their environments, and possible selves</td>
</tr>
</tbody>
</table>

Table 2: Metacognitive constructs in self-regulation

<table>
<thead>
<tr>
<th>Self-regulation phases\textsuperscript{24}</th>
<th>Sub-processes of self-regulated learning\textsuperscript{22,24}</th>
<th>Operational research elements, definitions, and objectives</th>
</tr>
</thead>
</table>
| Forethought                                | Self-observation                                              | - Define current situation of self  
- Awareness of one’s activities, personal characteristics  
- Reflection on experiences to build self-knowledge  
- Purpose and goal setting  
- Establishing the standard |
| Performance                                | Self-judgement                                                 | - Assess current situation  
- Compare to a standard  
- Define current self and possible self |
| Self-reflection                            | Self-reactions                                                 | - Affective domain considering one’s emotional reactions,  
- Making motivational and behavioural adjustments |
Drawing from the literature on selfhood and self-regulation, the workshop exercises were designed to explore student’s self-knowledge and encourage their self-awareness, self-reflection and metacognitive abilities. For students’ learning, the application of the self-regulated learning model to the workshop design aimed to simulate and scaffold the type of reflection and metacognitive skills of a self-regulating learning experience. In this way, the workshop exercises operated on two levels to serve both the research objectives and the workshop objectives respectively: 1) a social-cognitive level to investigate students’ sense of agency, purpose, and self-knowledge and 2) a metacognitive level to engage students in the self-regulation subprocesses as an experiential learning opportunity. A selected example of the workshop exercises is provided in the Appendix to demonstrate the alignment between operational workshop questions, research constructs, and theoretical underpinnings. This example represents the first of four parts, approximately 25% of the activities, undertaken in Workshop 1.

**Exploring the self: Utilizing a personal statement to engage students’ current and possible selves**

For students to be agents in their learning, we posit that a deep understanding of themselves, their values, and their goals is necessary. The workshop sessions are framed around writing a personal statement to describe how one sees himself or herself in engineering education. Workshop 1 serves to engage students in reflective thinking that would support them in writing their personal statement. It is intended that students have one week (the time between Workshop 1 and Workshop 2) to draft their personal statement and bring a copy to Workshop 2 for peer feedback and discussion. The personal statement writing task is framed in the first workshop as follows:

*Some time ago, you started your formal education in engineering. Where are you now and how did you get here? In less than a few years or months, you will have completed your undergraduate studies in engineering. What will you do next? Where will you go? How will you get there?*

*In response to the above questions, write a personal statement that describes how you see yourself in relation to your engineering education now, and how you envision the person you wish to become in your future engineering career.*

Our approach is for participants to formulate their personal statement that reflects their sense of self, values and goals in a meaningful way. We wish to encourage students to think about themselves in their engineering education as a way to formulate a reference position of thoughts, feelings, and actions—that is, the behaviour they currently engage. As well, by having students think about who they hope to become in their future career, they may be better able to articulate their possible selves. In this way, the personal statement may serve to position and prepare
participants to engage in self-regulated learning by setting a foundation for goal setting, establishing the standards for comparison, and providing the means for motivational and behavioural monitoring\(^5\).

Although the personal statement is to be written outside of the workshops, the workshop exercises were designed to support students in writing their personal statement by offering the time and space for reflection, discussion, and peer feedback. The specific workshop exercises target elements of the personal statement to inspire participants with ideas and content for formulating their personal statement. We posit that participants’ personal statements will support them in identifying their possible selves in a learning context and encourage goal-setting for their overall education, student experience, and future career.

**Workshop Implementation**

A pilot study is in progress to assess the effectiveness and alignment of the workshop methods. Workshop sessions have been scheduled for March 2015 and data analysis will be conducted by May 2015.

**Participants**

The workshop program will be offered to all undergraduate engineering students in all disciplines and all years of study. The program consists of the same format and exercises for all participants and it is intended that participants in the same academic year work together during the workshop discussion exercises.

We recognize that highly motivated and academically engaged students may be more inclined to participate in this research, posing a potential for self-selection bias among the participants. However, this study does not aim to draw comparative conclusions of participants’ responses or to identify distinct ways of experiencing the phenomenon. While the self-selection bias is a limitation, future work may consider ways of engaging diverse student participants.

With the nature of this study, participant self-selection is preferred as it may serve to protect the integrity of the research data while upholding responsible research practices. There is a concern that participants who are not sincerely interested in the professional development activities may intentionally contribute non-authentic data. Also, while we believe that these professional development activities are important to students’ educational experience, the activities may be perceived as being beyond formal academic requirements. Therefore, we believe that the implementation of mandatory participation may be unethical.
Recruitment

Recruitment methods consist of posters in engineering buildings, email messages through departmental mailing lists and social media, and email notices in the engineering society newsletter. A project website has been created to provide more information and an information session is scheduled prior to the start of the workshops.

Workshop Exercises

The complete workshop program consists of two workshops, each two hours in duration. At the beginning of each workshop session, participants are asked to answer three unique identifying questions, so that each participant’s responses can be tracked without personal identification. In Workshop 1, participants complete an entrance questionnaire to establish participant context, academic background, goals, and baseline perceptions.

Workshop 1 exercises were designed to support students in writing their personal statements outside of the workshop. Participants’ responses to the reflective exercises will be collected using the web-based FluidSurveys platform, which also allows participants to save a copy of their reflections to assist them when writing their personal statement.

The formats of both workshops follow a guided reflective process where participants are first prompted to reflect on a question about themselves or their experience, and then discuss their thoughts with their peers. Participants are also prompted to reflect on the peer discussion and to capture any new insights or perspectives that resulted from the peer discussion.

Participants will be required to bring a hardcopy of their draft personal statement to participate in Workshop 2. Workshop 2 consists of a peer feedback session with participants’ draft personal statement, as well as peer discussion on their overall experience of writing the personal statement, their personal development in the workshops, and their strategies, where applicable, for moving forward with their personal statement. After Workshop 2, participants will have approximately one week to submit the final version of their personal statement.

While we have outlined the design of a professional development workshop program that serves to apply and integrate theories of motivation, metacognition, and self-regulation, it is important to emphasize that the subject of this study is the participants’ sense of self as a way to support self-regulating behaviour. Research data, consisting of participants’ reflections from the workshops as well as their personal statements, will be qualitatively analyzed for categories and themes of description within the conceptual areas of participants’ sense of agency, sense of purpose, and sense of self-knowledge in an engineering education context (Table 1). From this
analysis, we seek to gain insight into three interrelated outcome spaces: 1) student learning 2) teaching practice, and 3) curriculum development and assessment (Table 3).

Table 3: Outcome spaces to frame qualitative analysis.

<table>
<thead>
<tr>
<th>Outcome Space</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student learning</td>
<td>Designing experiences and strategies for the promotion of self-regulated learning</td>
</tr>
<tr>
<td>Teaching Practice</td>
<td>Integrating and aligning teaching methods towards self-regulated learning</td>
</tr>
<tr>
<td>Curriculum Development and Assessment</td>
<td>Broader curriculum reform to support self-regulation and authentic assessment of lifelong learning skills</td>
</tr>
</tbody>
</table>

As an exploratory investigation, this research is not seeking to measure students’ levels of self-reflection, self-regulation, or engagement in these processes. The workshop exercises do not take an instructional approach to teach students about lifelong learning or to target the development of related competencies. Additionally, our research goal is not to directly investigate the self-regulating processes of students, although this may be an outcome of the study. Instead, we aim to position students for self-regulation, by scaffolding their learning through an experience that will expose them to self-regulating behaviours. We apply self-regulation theory to engage students in ways that may be meaningful to them.

Conclusion – Envisioning the future for research into the self

One of the purposes of engineering education research is the pursuit of innovative pedagogy to enhance teaching and learning. This paper has described the research and development of a professional development workshop series aimed at engaging students in self-reflection about their personal agency, sense of purpose, and self-knowledge. Our work explores students’ sense of selves as it relates to their motivation and self-regulation in their engineering studies. An integration of research and workshop objectives enabled the workshops to be utilized as a research instrument, while offering participants intrinsic value towards their personal development. The workshops provided a learning opportunity for students by challenging them in their thinking, and allowing for discussion with their peers, feedback and sharing of ideas.

Moving forward, there are a number of directions and opportunities for this research. An exploration into current engineering students’ sense of selves may reveal new insight applicable to engineering recruitment and retention efforts. Beyond a written personal statement, future workshop offerings may consider other research methods that allow for the expression of ones’ self in other forms, such as photo collections or elicitation, and multimedia presentations. Future work may also consider the applications of a student’s sense of self to other interdisciplinary
areas and engineering domains such as ethical behaviour, teamwork and collaboration, leadership, creativity, and problem solving.

One opportunity for this research may be to partner with academic support units, faculties, and departments across campus, such as career services, student affairs, learning commons, exchange and experiential learning groups, and centres for teaching and learning. By forming collaborations and partnerships with these units that share a role in the student experience, it may be possible to bring further awareness and engagement in professional development opportunities that target students’ self-exploration and self-discovery. We emphasize the need for a strong integration and concerted effort across academic support units, groups, and faculties, to bring value to students’ experiences. Can higher education play a role in helping students become intrinsically motivated in their studies? We cannot assume that students who are in our classrooms actually want to be there or can articulate why they are there in the first place. With this research, we challenge the culture of higher education to go beyond the role of academic learning and career preparation, and to consider its role in holistic student development.

Self-regulated learning is the process of determining, sustaining, and adjusting one’s behaviour to achieve desired academic outcomes. Based on the many applications and implications of the self in self-regulated learning, our research explores the domain of students’ self-knowledge, sense of agency, and sense of purpose in engineering education. This exploration may offer insight to support students’ self-regulation, to enhance our teaching practice, and to develop curriculum innovations.

References


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**Appendix**

*Selected Part 1 of Workshop 1 exercises with targeted conceptual research area and corresponding self-regulatory process.*

<table>
<thead>
<tr>
<th>Operational Questions</th>
<th>Social-cognitive level (Conceptual Research Area)</th>
<th>Metacognitive level (Self-Regulation Theory)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 1: Motivation for learning in engineering education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In small groups of 2-3, discuss and write down your thoughts to the following questions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. In your opinion, from a student perspective, what does “taking responsibility for learning in engineering education” mean to you?</td>
<td>Agency</td>
<td>Self-observation</td>
</tr>
<tr>
<td>2. How would you describe the purpose of your learning in engineering education?</td>
<td>Purpose</td>
<td>Self-observation</td>
</tr>
<tr>
<td>3. Do you feel like you have a sense of responsibility for your learning now? How? In what way?</td>
<td>Agency</td>
<td>Self-judgement</td>
</tr>
<tr>
<td>4. Do you feel like you are encouraged to take responsibility for your learning? How? In what way?</td>
<td>Agency</td>
<td>Self-judgement</td>
</tr>
<tr>
<td>5. In what ways do you currently practice your sense of responsibility?</td>
<td>Agency</td>
<td>Self-reaction</td>
</tr>
</tbody>
</table>