



Using a Structured Approach to Reflective Journaling in Engineering Leadership Development

Dr. John Donald P.Eng., University of Guelph

John Donald, Ph.D., P.Eng., is an Associate professor at the University of Guelph with over 25 years experience in leadership roles in engineering consulting and post-secondary education. A past President (2017-18) of the Canadian Engineering Education Association (www.ceea-aceg.ca), John is focused on excellence in engineering teaching practice, engineering leadership development and engineering design practice.

Dr. Paul C Hungler, Queen's University

Dr. Paul Hungler is an assistant professor in the Department of Chemical Engineering and Ingenuity Labs at Queen's University. Prior to starting his current position, Major (Retired) Hungler served in the Royal Canadian Airforce. His research is now focused on developing virtual and augmented reality for the next generation of simulation in education and training.

Kaitlyn Brant, Queen's University

Kaitlyn Brant, BScE, MEng, is a recent graduate of Queen's University. She has obtained degrees in both geological and mining engineering where she has most recently focused on the concepts of socially-conscious and socially-sustainable engineering. Kaitlyn believes that through education and leadership training, the next generation of engineers can fulfill their obligation to work sustainably and ethically within the diverse communities of Canada and the world.

Ms. Stephanie Diane Shaw, University of Guelph - School of Engineering

Stephanie is a Professional Engineer and Ph.D. Candidate in the School of Engineering at the University of Guelph. Her research is focusing on product development of air quality purification technologies for urban environments. Her current degree is in Environmental Engineering, and she previous education includes an M.A.Sc. in Environmental Engineering (renewable energy), from the University of Guelph, and her B.Eng. in Materials Science and Engineering, from McMaster University. Stephanie has been involved with engineering leadership in both academic and corporate capacities for numerous years. After completing her M.A.Sc. she worked in industry for four years, during which time she took part in and helped host engineering leadership sessions within her company. She has also taken a graduate course in engineering leadership since returning to academia for her Ph.D.

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John Donald, Paul C. Hungler, Katlyn Brandt, Stephanie D. Shaw

American Society for Engineering Education Annual Conference & Exposition, June 2020.

Abstract

Reflection is an active learning technique that can be used to encourage greater understanding and act as a metacognitive strategy to develop lifelong learning skills. This “Work-in-Progress-Assess” paper presents a research study related to a weekly leadership reflection journal assignment that is carried out in graduate level Engineering Leadership courses at two Canadian Universities. The specific objectives of this study are to explore the impact of structured reflection on engineering leadership development by: 1) examining the effectiveness of structured reflection for developing engineering leadership skills, and 2) identifying how the insights gained through reflective practice will be applied in students’ careers.

As a foundation, we deliver a structured Describe-Analyze-Evaluate (DAE) reflection model based on Bloom’s taxonomy. We then ask the students to complete a weekly reflection journal over the semester using this structured framework. Quantitative information is gathered to evaluate the research questions in the form of surveys and peer assessments. Surveys are also used to quantify student perception of the effectiveness of the reflection framework and the journaling assignment. The sources of influence for the leadership reflections (e.g., politics, family, course material, movies) and the reflection’s relevancy to the student’s personal leadership development (e.g., core values, team work, conflict management, listening skills) are identified and discussed in the context of how these aspects may evolve as a result of regular reflection. The results indicate that the weekly journaling exercises were valuable and allowed students greater insight into leadership development skills related to relationships and team building, as well as personal character development and conflict resolution. The data gathered during this first phase of the study will help structure the second phase, where a mixed methods approach will be employed. Qualitative data from the reflections will be examined with a focus on evaluating the effectiveness of structured reflection on leadership skills development, where the depth, quality and focus of the actual reflections will be analyzed to identify student perceptions of leadership.

1.0 Introduction

There is an increasing awareness that engineers need to be prepared to take greater responsibility for the impact of technology in the societal context. Engineering accreditation bodies, such as the Canadian Engineering Accreditation Board (CEAB) and the Accreditation Board for Engineering and Technology (ABET), now explicitly include criteria to ensure that engineering graduates develop competencies in understanding the impact of technology on society from an number of contexts, including ethics, economics and the environment [1][2]. This increasing awareness of the need for engineers to be prepared for the broad role of stewarding technology at the societal level has led to initiatives such as the “Engineering Change Lab” in both Canada [3] and the United States [4]. Some engineering schools are also using frameworks such as the United Nations Sustainable Development Goals (UN-SDG’s) [5] as a framework to actively consider the role engineers can play in the impact of technology in society [6].

Developing leadership knowledge, skills and attitudes is key to engineers being able to influence and steward the impact of technology on society. To support this need, it is important for engineering programs to be able to develop and assess leadership competencies in engineering students. One method is through the active learning strategy of reflective journaling of leadership experience. In this paper, we look at a “Leadership Reflection Journal” assignment that is carried out in graduate level Engineering Leadership courses at two Canadian Universities. The specific objectives are to explore the impact of structured reflection on engineering leadership development by: 1) examining the effectiveness of structured reflection for developing engineering leadership skills, and 2) identifying how the insights gained through reflective practice will be applied in students’ careers.

2.0 Reflection Model – Describe-Analyze-Evaluate (DAE)

Engineering leadership is increasingly offered as an explicit and intentional area of study in the engineering curriculum. As a result, a number of studies have worked to catalogue and classify the number and nature of engineering programs [7] [8] [9]. Engineering leadership development is often approached from the perspective of “personal” leadership development. This focuses on the importance of developing a personal approach to leadership [10] and the importance of metacognition, reflective practice, and peer-evaluation, which are often identified as key facets of the leadership development process [10][11]. Reflection as an active learning practice is particularly useful for consolidation of learning concepts and is utilized both inside and outside engineering education [12] and has been identified as a key mechanism for personal leadership development [13] which can aid in the developing a personal leadership philosophy. Given the technical focus of the engineering curriculum, it is useful to provide a structured model for reflective practice. The structured reflection model used in this study was based on “A Taxonomy of Reflection: A Model for Critical Thinking” by James Pappas [14]. The model follows Bloom’s Taxonomy in the Cognitive Domain [13][14], which is summarized into distinct categories of Describe, Analyze and Evaluate (DAE). The model is presented visually to the student (see Figure 1), with supporting examples and an overview of how Bloom’s action verbs can fit into each domain; ‘Describe’ captures Bloom’s Remember/Understand, ‘Analyze’ captures Apply/Analyze and ‘Evaluate’ captures Evaluate/Create.



Figure 1. Describe-Analyze-Evaluate Framework

In addition, to further aid the students in their leadership reflections, students were also presented question prompts for each of the DAE elements, as presented in Table 1.

Table 1. Describe-Analyze-Evaluate Framework Questions

Framework Element	Prompting Questions
Describe	What did you observe? Who did it? What steps were taken?
Analyze	What insights were gained? Were there patterns? Why was it important?
Evaluate	What is the relative importance? What needs to improve? How can I apply personally?

3.0 Methodology

A leadership reflection journal assignment was incorporated into the graduate engineering leadership courses at two Canadian Universities: Queen’s University in Kingston, Ontario in the fall of 2019; and, University of Guelph, in Guelph Ontario in the winter of 2020. The graduate students in these courses were required to complete one reflection per week for eight weeks using the DAE reflection model. The reflection topic selected by the students was completely open. The intention was to inspire students to notice activities or experiences during their daily lives, reflect on these experiences, and relate them to their own personal leadership development.

The reflections were submitted in the course learning management system in the form of a survey. In addition to the reflection itself, students were asked to identify the source of influence for their reflection (i.e. personal life, media, history, etc.) and the reflection’s relevancy to the student’s personal leadership development (i.e. character development, team building, decision making, career, etc.). Students were able to select a multitude of sources of influence and relevancy. The written portions of the reflections for each student were also uploaded to a peer feedback tool [17],[18]. Each student was anonymously and randomly assigned two peer submissions and asked to evaluate and provide constructive feedback. The students were provided a rubric to evaluate their peers’ reflections on a scale from 0-3 (below expectations (0), marginal (1), meets expectations (2), outstanding (3)) based on the quality of the reflection with respect to all three elements of the DAE framework. The quality of the peer feedback was also evaluated by teaching assistants on a similar scale from 0-3. The peer feedback portion of the reflective journal was used to provide timely constructive feedback and to provide an opportunity for students to consider what factors were influencing other students’ reflective process.

Following completion of the eight weekly reflections, students were required to complete a meta-reflection to examine the value and impact of the entire leadership reflection journaling experience on their personal leadership development. Figure 2 illustrates the timing of the different components of the reflective journaling assignment throughout the delivery of the course. The meta-reflection was completed in the form of a survey with three main questions

each containing sub-questions. All three questions had an area for free form text reflection and some focused questions on a five-point Likert scale. The first question examined how valuable the students found the reflective process. The second question focused on the perceived importance of self-reflection in different aspects of students' lives. The final question in the meta-reflection focused on how often students foresee the skills of self-reflection being incorporated into their personal and professional decision making in the future.

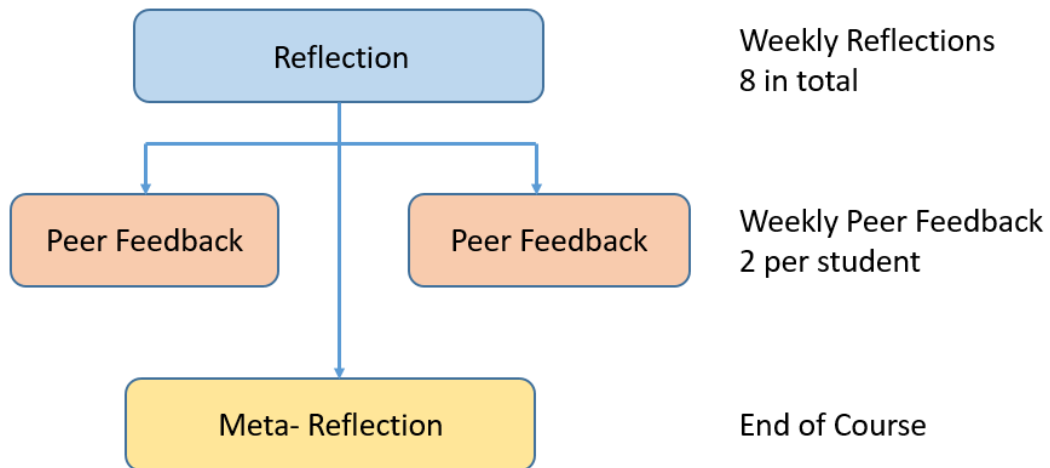


Figure 2. Timing of leadership reflective journaling during course delivery

4.0 Results & Findings

Results from the first stage of research, completed at Queen's University in the Fall of 2019, have been compiled and some insight can be extracted from the information. The results are presented in two categories: weekly reflections and the meta-reflection. The two key areas for qualitative assessment of the weekly reflection responses that have been gathered at the time of this paper's submission are: one, an assessment of the 'Sources of Influence' that inspired the leadership entries; and two, 'Application to Life' (i.e. areas where the student might apply the learning in their own leadership or personal development). Additionally, results linking back to the research questions, as presented in Section 1.0 Introduction, are presented at the end of this section. The total class size was 34, and a subset of the class consented to participate in the study. For the eight weekly reflections, the number of students responding ranged from 16 to 18, except for Week 3, where 12 students responded. Seventeen (17) students completed the meta-reflection.

4.1 Weekly Journal Reflection Surveys

Weekly leadership reflections were strongly sourced from 'Teamwork and Professional Environment' and 'Personal Life' experiences. These two sources ranked the highest each week among the students (see Figure 3), and this trend continued for each of the eight weeks that the reflections were completed. Ranking lower in influence as sources for leadership reflections were educational experiences, and stories from current media or historical references.

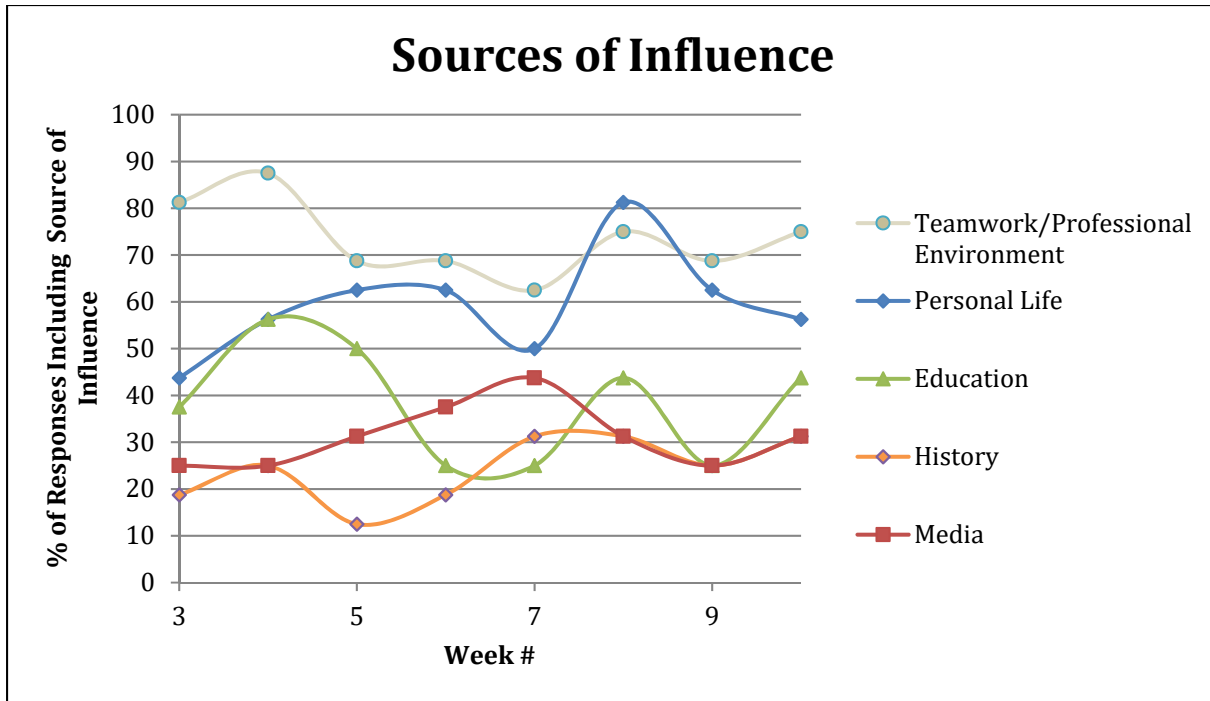


Figure 3: Sources of Influence as reported in the weekly reflective surveys.

When examining the areas to which students felt they could apply their leadership reflection insights, weekly results indicate that ‘Relationships and Team Building’ was the most relevant area (see Figure 4). ‘Character Development’ was the second area that emerged as a top application area, though this trend was not clear on a weekly basis and surfaced only when examined over the duration of the eight weekly reflections. Interestingly, students consistently placed ‘Conflict Management’ and ‘Entrepreneurship and Innovation’ as the two areas with the least application in their life. This is especially curious given the fact that the Queen’s University Fall 2019 Leadership Course is also focused on “Innovation”. Trends in the remaining four areas of application are more difficult to describe, as the rankings of these areas fluctuated significantly on a weekly basis.

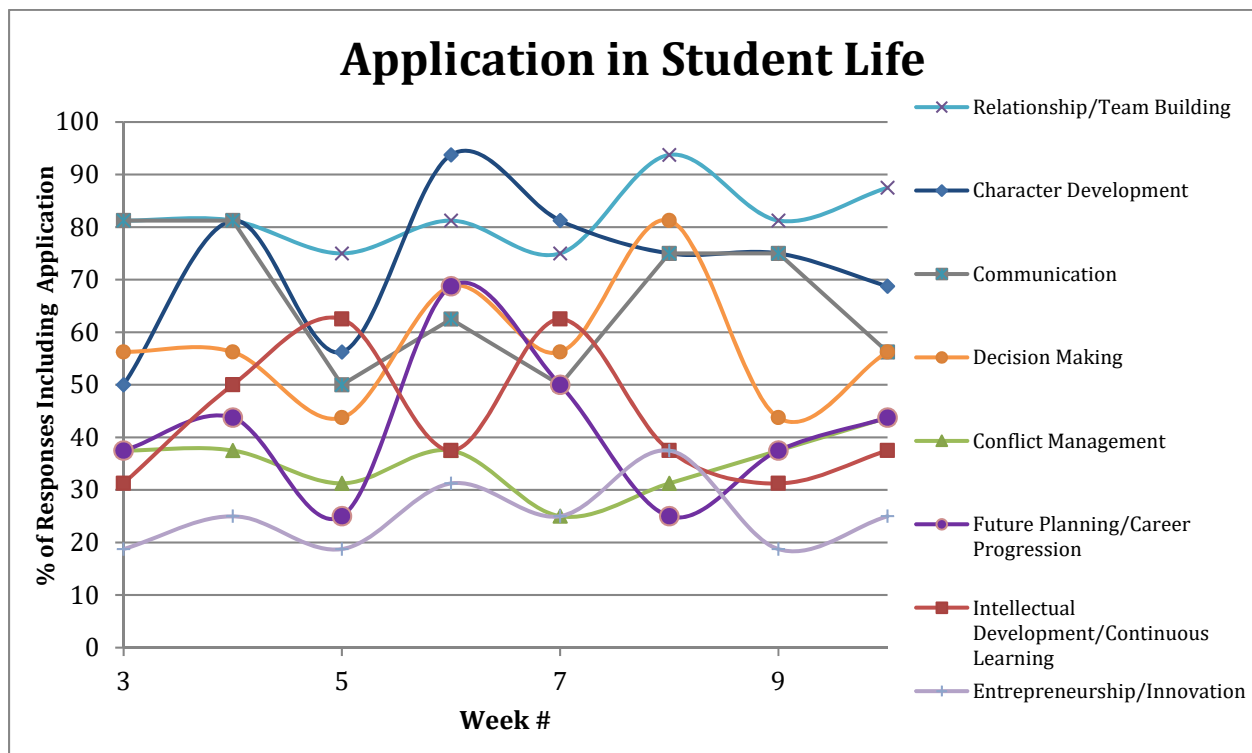


Figure 4: Application of reflection in student life as reported in the weekly reflective surveys.

4.2 Meta-reflection – Area of Application

The students carried out meta-reflection exercises at the end of the Fall 2019 term, after completing the eight weekly reflections, to assess their overall reflective journaling experience. Numerous questions were posed to the students, and to align and relate the meta-reflection results to those gathered in the weekly reflections, two particular questions are reviewed at this time. These two questions relate to how the students feel they will apply their reflective learning in their life and in their leadership development. These future-looking questions prompt the students to consider application of their reflections on leadership in the practical context of how it can relate to their own personal leadership development and personal leadership philosophy. It is also can reinforce the “Evaluate” component of the DAE reflection model.

The first question examined is an assessment of student response to the meta-reflection survey; “Please select the response below that best represents the level of importance self-reflection will likely have on each of the following aspects of your life”. Students rated the importance of each category on a scale of 1 to 5, ranging from Very Unimportant to Very Important respectively. The results are presented in Figure 5, with the values provided being the average reported by all consenting participants. Students identified ‘Planning for the Future’ as the top area that leadership reflections will have on their lives, followed closely by ‘Relationships and Team Building’. This result is slightly unusual in that it supports rankings from the weekly reflection assessments that place ‘Relationships and Team Building’ as a top area of application, though ‘Planning for the Future’ is not found to be as important on a weekly basis. This observation may

indicate that weekly individual assessments of leadership value are applicable to areas of immediate relevance, but, when asked to pause and reflect on an entire experience, students are able to see the value of self-reflection on longer-term areas of their life such as ‘Planning for the Future’.

Following the two aforementioned areas, ‘Communication’ and ‘Conflict Management’ were ranked as the third and fourth areas of application of the leadership journal experience based on meta-reflection results. Interestingly, neither of these areas were ranked highly on a weekly basis, and ‘conflict management’ was even identified as the second lowest area. This again may signal that individual weekly leadership reflections have more immediate application to the students’ lives, but the overall reflection experience holds different value in areas that may not be encountered on a daily basis.

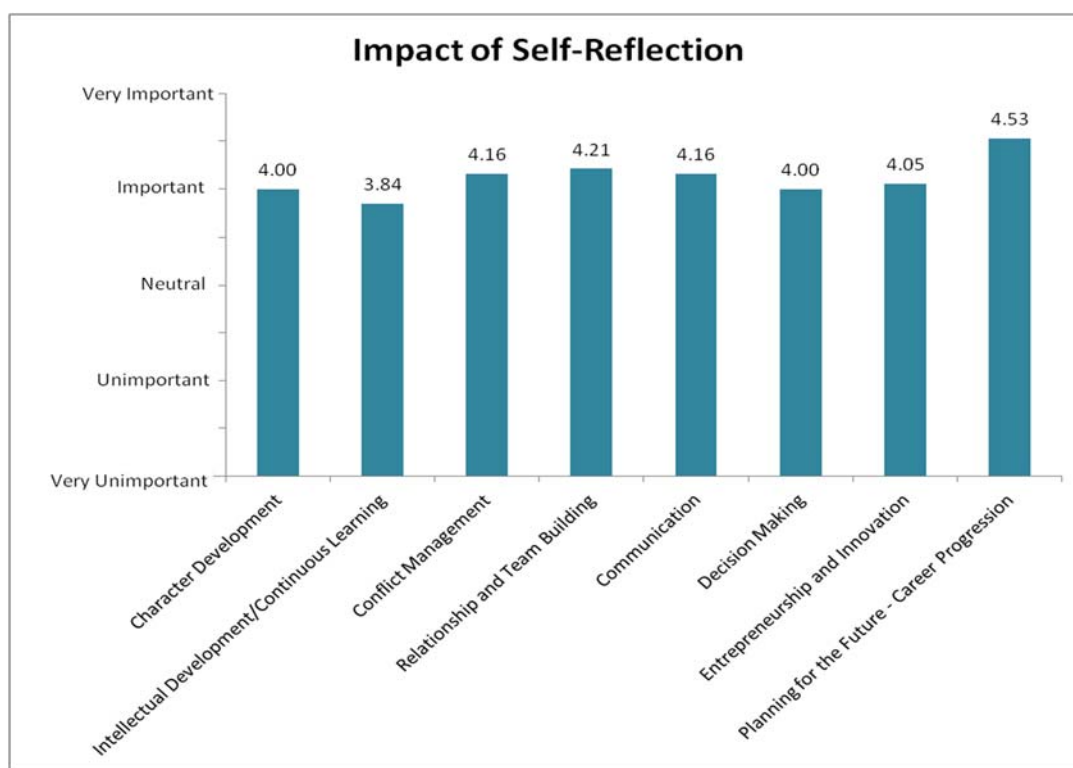


Figure 5: The impact of self-reflection identified by students in the final meta-reflection.

The second meta-reflection question examined by the research team was student response to “How often will skills of self-reflection be incorporated into personal and professional decision making in the future?” Students rated the frequency of incorporating self-reflection into each category on a scale of 1 to 5, ranging from ‘Never’ to ‘Always,’ respectively. Results from this question are presented in Figure 6 and find that ‘Personal Development’, ‘Personal Development and Lifelong Learning’ and ‘Team Building and Conflict Resolution’ are the top three areas where students will most often apply leadership insight. For the ‘Personal Development and Lifelong Learning’ category, students were instructed to focus on lifelong learning. In future surveys the categories will have better delineation to prevent any overlap or confusion.

These results again reinforce that ‘Team Building’, identified as a top area of application on a weekly basis, is an area where students feel that leadership principles are commonly employed. Conversely, ‘Conflict Management’ and ‘Lifelong Learning’ were not areas of great importance on a weekly basis, but have clearly emerged as such after a semester of reflection.



Figure 6: How students foresee incorporating self-reflective principles moving forward

4.3 Impact of Meta-reflection on Leadership Skill Development

As part of the meta-reflection exercises, the students were asked to rate their assessment (1-Very Low Value, 2-Low Value, 3-Neutral, 4-High Value, 5-Very High Value) of the following questions:

- 1) Prior to completing the self-reflective exercises, how well did you feel you understood your personal attributes, values, goals and aspirations?
- 2) Ultimately, how valuable do you feel the self-reflective exercises were in revealing and enhancing your awareness of your own personal values and goals?

Results from this personal evaluation yielded an average response of 3.37 and 3.79, for questions 1 and 2 respectively. The intention of these questions is to identify if the students found value in performing self-reflections as a means of gaining better self-awareness in understanding personal attributes, values, goals and aspirations as they relate to leadership skills. While not directly comparable as measures, these results indicate that looking back on the experience, students on average rated their self-understanding somewhat higher than neutral, while their assessment of the value of the reflections approached the “High Value” rating.

While these results cannot be used to directly answer the first research question established by the team, “examining the effectiveness of structured reflection for developing engineering leadership skills”, it does indicate the students are seeing improvements in their self-awareness, a foundation on which to build leadership skills, as a consequence of completing reflection exercises.

5.0 Conclusions and Recommendations

Data and information obtained during the first stage of this “Work-in-progress” research study provided insights into aspects of reflective journaling for engineering leadership development and will be used to shape the subsequent stages. Preliminary results shed light on the second question posed by the research team, “identifying how the insights gained through reflective practice will be applied in students’ careers”. Weekly reflections indicated that the sources of influence and application in the student life fluctuated on a week to week basis but there were clear trends indicating an emphasis on “Teamwork/Team Building” and “Character Development”. Through the examination of weekly and meta-reflection data it was apparent that weekly reflections tended to focus on topics immediately applicable to the student’s daily life while for the end-of-term meta-reflections students tended to see the applicability of the reflective process in “Planning for their Futures” and applying leadership thinking to “Character Development” and “Team Building and Conflict Resolution”.

Results from the first stage of the study indicated that some of the questions in the weekly and meta-reflection surveys may not allow for a direct assessment of the first research question focused on assessing the effectiveness of structured reflection on the development of leadership skills. As a result, some questions will be modified or added to the surveys for the next stage of research to allow for better assessment of the desired research questions. Furthermore, the research team plans to employ a mixed-methods approach to the data. Quantitative performance data from the reflections will be examined, and the depth, quality and focus of the actual reflections will be analyzed to identify student perceptions of leadership. The effectiveness will be evaluated by examining the depth and quality of the journal entries over time and also through the coding of leadership concepts discussed by the students (e.g., authentic leadership, coaching, mission-vision-values).

For future studies the research team recommends adding a longitudinal study after graduation to reassess the student’s opinions regarding the impact of the reflective journaling process and if students continue to employ aspects of reflection for career and personal leadership development.

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