THE ROLE OF REFLECTION

IN LEARNING THROUGH EXPERIENCE

THE ROLE OF REFLECTION IN LEARNING THROUGH EXPERIENCE:

A FRAMEWORK AND GUIDE FOR STUDENTS AND EDUCATORS

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Lay Abstract

The research reported here covers the following items: (1) the development of the Reflective Learning Framework (RLF), which was accomplished through a bottom-up approach, and which began with reading and re-reading over 100 student reflections and then reviewing the wealth of literature on the topics of reflection and experiential learning; (2) an investigation of students' responses to the RLF, which was accomplished through an online survey and in-person interviews; and (3) determining the effectiveness of the RLF by comparing the grades of students who used the RLF to those who did not. The results of these studies demonstrate the overall effectiveness of the RLF as a tool to guide, assess, and evaluate reflection through experiential education in university courses.

Abstract

The research reported here covers the following items:

1. **The development of the Reflective Learning Framework (RLF)**. This framework was developed based on a grounded theoretical approach combined with an exploration of existing student reflections; then-current literature; and years of multiple iterations through real-world trials. This framework has now successfully been used by many educators in courses at McMaster and other institutions of higher education.

2. **An investigation of students' responses to the RLF**. Following the development of the RLF, third-year students who had used the RLF to guide, assess, and evaluate their course reflections were surveyed and interviewed about their perceptions of using the RLF. Results of this study demonstrate that students see reflection as a tool to develop and use cognitive and metacognitive skills, and also as a tool to support knowledge retention and transfer. Furthermore, findings suggest how reflection, as studied, contributes to the acquisition of higher-order thinking skills required to address the complex challenges of improving sustainability.

3. **Determining the effectiveness of the RLF**. Finally, to determine the effectiveness of the RLF to support students in applying and demonstrating their higher-order thinking skills, a comparison of two sets of reflections was performed – one that used the RLF and one that did not. The comparison was based on tests of interrater reliability and a comparison of means was conducted. The results of this study demonstrate the reliability of the Framework to be used by multiple raters and that significantly different reflection outputs were obtained from students who used the RLF compared to those who did not.

The results of these studies demonstrate the overall effectiveness of the RLF as a tool to guide, assess, and evaluate reflection through experiential education in university courses.

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List of Abbreviations

ICC   Test of intra-class correlation

IRR   Test of interrater reliability

M   Mean

p; p-value   Probability value

R   R statistical software and R Studio package

RLF   Reflective Learning Framework

SD   Standard deviation

SUSTAIN   Code for courses in McMaster University's Sustainable Future Program

SUSTAIN 1S03   First year, one semester course, *Introduction to Sustainability*

SUSTAIN 2S03   Second year, one semester course, *Evaluating Problems and*

                Sustainable Solutions

SUSTAIN 3S03   Third year, one semester course, *Implementing Sustainable Change*

t-test   Statistical hypothesis test

t (…) = …   t-statistic at a particular number of degrees of freedom

TA   Teaching Assistant

Preface

This thesis is a composite of three substantive chapters, that are either published (Chapter 2), accepted for publication (Chapter 3), or in preparation for submission (Chapter 4). As the lead author, I forged the basis of each chapter, including the hypothesis, study design, Ethics[1] review and approval, data collection and analysis, and preparation of the resulting manuscripts. Dr. Antonio Paez, the second author and my PhD supervisor, provided support and guidance at each phase and throughout the development and execution of each chapter. Dr. Paez also provided direction, training, and significant support for the quantitative data analysis in Chapter 4.

You as the reader will find some amount of repetition between the substantive chapters of this thesis. This is a consequence of the chapters having been prepared originally as stand-alone documents for submission as journal papers.

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[1] Capitalization signals reference to the McMaster Research Ethics Board

Chapter 1: Introduction

Experiential learning has resurfaced as an important approach to university education in Ontario and other jurisdictions as well (e.g., Roberts, 2018). In the case of Ontario, in 2014 the Ministry of Training, Colleges and Universities (now the Ministry of Advanced Education and Skills Development) requested in that all institutions of post-secondary education across the province include experiential education as a major focus in their strategic mandate agreements with the province. By 2015, the Canadian federal government was investing in co-op placements for students (Liberal Party of Canada, 2015), and in 2016, *The Premier's Highly Skilled Workforce Expert Panel* recommended that "every student has at least one experiential learning opportunity by the time they graduate from post-secondary education" (p.27).

As part of this push by provincial and federal governments, post-secondary institutions across Canada committed to increase the exposure of their students to experiential education, and investments were put forward to this end. Generally speaking, instructors at these institutions were well-equipped to incorporate experiential education techniques into their classroom. The discipline of geography, for example, has a long history of experiential education in the form of fieldwork (Dummer et al., 2008; Healey 2005). However, the tools to support and evaluate experiential educational approaches were, and remain still, relatively underdeveloped. A distinction that is rarely made but that is important in this context is in the definitions of experiential *education* and experiential *learning*. For example, The Association for Experiential Education (undated) defines experiential *education* as: "a philosophy … in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, clarify values, and develop people's capacity to contribute to their

communities." In their book, How Learning Works, Ambrose et al. (2010, adapting from Mayer, 2002) describe three critical components of *learning*:

> 1. Learning is a *process*, not a product. However, because this process takes place in the mind, we can only infer that it has occurred from students' products or performances.
> 2. Learning involves *change* in knowledge, beliefs, behaviours, or attitudes. This change unfolds over time; it is not fleeting but rather has a lasting impact on how students think and act.
> 3. Learning is not something done *to* students, but rather something students themselves do. It is the direct result of how students interpret and respond to their *experiences*—conscious and unconscious, past and present (p. 3)

As these definitions make clear, a key difference between these definitions is that education is something that educators do to help students to learn, but that the learning is a process in the learner's mind. As such, it is important to recognize that just because students engage in an *educational* experience, it does not necessarily follow that they will *learn* from the experience.

This is a critical point.

Let us return to the recommendation from *The Premier's Highly Skilled Workforce Expert Panel* cited above. Once that experiential education becomes part of a policy framework, the need inevitably emerges to measure compliance with the policy. For people engaged in the implementation of institutional mandates on experiential education it soon became clear that there was a need for metrics to measure and report on the outcomes of experiential education. The simplest metric, of course, turned out to be the number of *opportunities* to learn experientially – and as night follows day, instructors soon had to fulfil requests to describe what opportunities for experiential learning were available in courses. This, while important as an

initial tally, should not distract from the important task of understanding how effective

experiential education opportunities are in terms of actual *learning*.

The focus on quantifying what educators and the institutions can control is

understandable (i.e., counts of courses with experiential education components). However,

beyond the administrative need to demonstrate compliance at this basic level, a pressing question

for instructors was about how to guide, assess, and evaluate students' learning through

experience – the tools for which were not, for the most part, readily available. This state of things

pervaded the initial efforts to implement experiential education beyond some niche courses and

proved to be particularly vexing with respect to more specific aspects of experiential learning,

including reflection. On the one hand, reflection is generally held to be an important aspect of

learning. On the other, how to implement reflection and assess it in a systematic way is a topic

that is insufficiently understood, or worse, misunderstood. The latter point is something that I

discovered through interactions with instructors in numerous fields over the course of developing

this research, thus leading to the need for resources, methods, and knowledge useful to

instructors who wish to effectively use and assess reflection as a component of experiential

learning in their courses.

Origin and motivation of this thesis

The origin of this thesis can be found in the way I interacted with the subject of experiential

education in the early stages of my PhD. Over the course of my career I have (had) multiple roles

in academia: as a university administrator, sessional faculty member, and part-time student, both

as a Master student and as a PhD candidate. In 2011, after several years as Sustainability

Manager for McMaster University, I was supported by the University's Vice President of

Administration and the Provost (aka, Vice President, Academic) in pursuing a new mandate, to develop a new academic department, namely the Academic Sustainability Programs Office. The focus of this Office would be on student experiential learning with a focus on sustainability. I was influenced during this enterprise by the work of educational philosopher John Dewy, who famously stated that "[t]he most important attitude that can be formed is that of the desire to go on learning." (Dewey, 1938, p.48) Guided by Dewey's work, I established that the mission of the Academic Sustainability Programs Office would be to "*inspire in all students a desire for continued learning through experiential education"* (https://asp.mcmaster.ca/). Therefore, my aim was to realize this mission by providing students with opportunities to participate in interdisciplinary, student-led, community-based, and experiential learning opportunities around the topic of sustainability. Despite my excitement to launch the first course in our undergraduate program, I could not ignore the fact, while the focus was on experiential education, I was at a complete loss as to how we (myself and instructional team members) would determine whether *experiential learning* had occurred; and this was before we could even know if experiential learning was impactful or, more ambitiously, transformational. After all, this is what I and a majority of educators strive for (Dur and Keller 2018; Liimatainen et al., 2001; Mezirow, 1998; Mezirow and Associates, 1990; Mochizuki and Bryan 2019).

There were some important questions that did not seem to have satisfactory answers in the literature. These included, "what kind learning do I hope our students have?", "is there a way for educators to support and guide student experiential learning in a way that still allows for failure, student autonomy, and authenticity?", and "in an environment of marks, grades, and grad-school applications, how do we evaluate student learning gained through experience?" My sense was that I was not alone and that other educators were facing similar challenges and asking

similar question. Furthermore, I anticipated that even if administrators and governments were not yet asking such questions about the role and evaluation of learning through experience, they would not be too far behind.

Reflection as a component of experiential learning: background and research questions

At an early stage of this thesis, an investigation of tools to guide and assess experiential learning did not take long to reveal a rich literature on the role of reflection in supporting experiential learning within and across disciplines (Boud, Keogh and Walker, 1985; Kolb, 2015; Mann, Gordon, & MacLeod, 2009; Mezirow, 1998; Moon, 1999; Kuiper and Pesut, 2004; Leijen, Lam, Woldschut, & Simons, 2009). Like the breadth and diversity of literature on the topic, definitions of what is meant by reflection also varied. In their book, *Fostering Critical Reflection in Adulthood*, Jack Mezirow and Associates define reflection, critical reflection, and critical self-reflection in this way:

> *Reflection*: Examination of the justification for one's beliefs, primarily to guide action and to reassess the efficacy of the strategies and procedures used in problem solving
> *Critical reflection*: Assessment of the validity of the *presuppositions* of one's meaning perspectives, and examination of their sources and consequences.
> *Critical self-reflection*: Assessment of the way one has posed problems and of one's own meaning perspectives. (1990. p. xvi)

Jennifer Moon, in her book *Reflection in Learning and Professional Development*, suggests that "…the apparent differences in reflection are not due to different types of reflection – in other words, to differences in the process itself, but to differences in the way that it is used, applied or guided." (p. 5) Moon goes on to describe that "[t]he term 'framework' is applied to these uses or applications or means of guiding the activity." (ibid)

The diversity of definitions, perspectives, and approaches were richly compelling –

however, they also presented challenge towards concrete understanding of the topic. Importantly,

learning from the literature on the topic of reflection proved to align well with my own

experiences and success obtained through relying on reflection as a source of learning. At a

practical level, the intuitions were solid: the importance of taking any situation as an opportunity

to learn; the relevance of preparing in advance; of being present during the experience; and to

take time to critically evaluate and plan for the next learning experience. Schön's work on *The*

Reflective Practitioner and his insights on how practitioners employ reflection-in-action and

reflecting-on-action (Schön, 1987) as strategies for learning provided an impetus, an aspirational

goal for students in the courses offered by the Academic Sustainability Programs Office. From a

personal perspective, I wanted students to stay curious, to continue learning, and to have the

well-developed skills and abilities to do so. And the more I learned about experiential learning,

the more I saw reflection as the missing link in our program and a key educational strategy that

would help us to achieve our mission.

Reflection, despite my conviction that it would play a key role in our programs, was not

straightforward to implement as an effective teaching and learning strategy. Although reflection

frameworks existed in the literature, they were not sufficient to confidently and reliably guide

and assess experiential learning through reflection. As such, with a focus on reflection as a tool

to support experiential learning, the over-arching two-part research question of this thesis

became, "*what is the role of reflection in learning through experience and how can educators*

guide, assess, and evaluate experiential learning through student reflection", questions for which

there were not, in my view, solid answers in the literature. Each substantive chapter in this thesis

(i.e., Chapters 2 through 4) addresses these questions from the perspective of developing a

learning framework, understanding how students respond to reflection, and the reliability and usefulness of the framework to guide and assess reflection, as described next.

Structure of the thesis

The thesis is prepared in the so-called "sandwich" format, which consists of three or more journal publications, bookended by an introductory and a concluding chapter. Besides this introduction, the thesis consists of three substantive chapters and a conclusion.

Chapter 2

As I began my research, I fully expected to find an existing reflection framework that would suit our courses and help us to meet our course learning outcomes and the mission of our program. However, despite my best efforts to apply the work of various authors (Boud, 2001; Grossman, 2009; Kember, McKay, Sinclair, & Wong, 2008; Leijen, Valtna, Leijen, & Pedaste, 2012; Ryan, 2011), I was unable to adopt or modify even one framework that I felt could be confidently used to guide, assess, and evaluate our students' reflections. This provided the impetus for the research presented in Chapter 2.

Chapter 2 reports the adoption of a grounded theory approach to discover the characteristics of a high-quality reflection. This process spanned over many years and led to the development and refinement of a novel framework for reflective learning. Following the grounded theory methodology set out by Corbin and Strauss (1990), the process was lengthy, rigorous, and included a significant focus on journaling. From a personal perspective, this process enabled me to become more knowledgeable about my students, their capacity for reflection and writing, and the diversity of topics, styles, and insights that could be presented.

The research reported in this chapter took the longest to accomplish, since it involved many years of testing and iteration before the Reflective Learning Framework (RLF) finally matured to a stage where it could undergo formal testing to assess its effectiveness in practice. Chapter 2 is a story of trial and tribulation, with a happy ending. This chapter was published as an article in the journal of Teaching & Learning Inquiry in March of 2019. My role in this chapter was as lead researcher and author, with my academic supervisor and co-author, Prof. Antonio Paez providing support, guidance, and a sounding board for the ideas presented in this chapter. Chapter 2 has been lightly edited from its journal version to conform to the formatting of the rest of the thesis.

Chapter 3

By the time the reflection framework was fully developed, thousands of data points, sample reflections, and qualitative feedback from multiple years of testing iterations of the framework had become available. It was then time to turn to the question of how students felt about their experience with the framework. In this way, Chapter 3 reports the first attempt to test the RLF at work.

A key question here was as follows: "when thinking about 'effectiveness', what is a measure of success?" My own view was first and foremost a successful student experience with the RLF. My belief was that if students did not have a positive experience with or find value in reflection through using the RLF, then it really did not matter to me how much academic rigour had gone into its development. If students did not like the RLF, then they were not going to use it beyond being required to do so in our courses. Not only is there a link between the affective (feeling) and cognitive (thinking) domains (Anderson et al., 2001; Boyle et al., 2007), but enjoyment in learning was also important to both my own educational philosophy and the

mission of the Academic Sustainability Programs Office. Furthermore, continuous (i.e., 'lifelong') learning is fundamental to our ability to solve complex sustainability challenges in an ever-changing environment (English & Carlsen, 2019; German Commission for UNESCO, 2009; Haigh, 2006; Wals & Benavot, 2017).

Although it may seem simple to just ask students who had used the framework their opinion of it, a benefit and a challenge was that I oversaw the academic program. This put me in a unique situation where I had convenient access to the students and support from the course instructors, while also raising real ethical concerns about using these students as my study participants. I was fortunate to have tremendous support from the Ethics advisors at McMaster University, and I was able to design a study that provided me with excellent response rates and results, while completely avoiding ethical issues.

As such, Chapter 3 describes the use of a mixed methods approach, involving a survey, in-person interviews, and students' reflections to investigate the way students respond to the RLF. Following guidance by Braun & Clarke (2006), a thorough thematic analysis of the data was done. By the end, I was both surprised and not at all surprised at what I learned, which was that students see reflection as a tool to develop and use cognitive and metacognitive skills. This was not surprising because these findings were consistent with literature pointing to the value of reflection in fostering higher-order cognitive (thinking) skills and also being metacognitive (thinking about one's own thinking) by its very nature (see Anderson and Krathwohl, 2001; Kuiper and Pesut; and Mezirow and Associates, 1990). The aspect that was surprising to me was that students felt and articulated (albeit in their own words) their awareness of the value of reflection in this regard. This chapter reports, in the words of the students, descriptions of the experience using the RLF and the major themes that were identified from the thematic analysis.

Upon completion, this chapter was submitted to the Journal of Geography in Higher Education in August of 2019 and accepted for publication in July 2020. As before, I was the primary researcher and author, with support from my academic supervisor and co-author, Prof. Antonio Paez.

Chapter 4

Chapter 3 provided evidence of the value that students find through their use of the RLF. Given the affective link with learning, this suggests that they probably were learning the skills that we hoped and intended that they would. However, students *feeling* that they had learned something does not necessarily mean that they *did* learn it. Specifically, the literature demonstrates that there may be disconnect between what students feel they learn through reflection and what they demonstrate (Brail, 2013; Dummer, 2008; Rioux, 2019). As such, an important question is whether the reflection framework would not only result in positive student perceptions about their learning but also support them in demonstrating higher-order thinking skills. Proving this question would, in my view, help me understand if any reflective framework would do, or if the RLF was more effective. For this reason, Chapter 4 investigates the students' ability to demonstrate their higher-order thinking skills through their course reflections.

In this chapter, two sets of reflections were compared. The first set of reflections used in this research was written before the RLF was developed, while the second was written by students who used the RLF for guidance, assessment, and evaluation. Following guidance by Hallgren (2012) and by Koo & Li (2016), tests of interrater reliability (IRR) to quantify the degree of agreement between independent evaluators were conducted. Multiple raters evaluated all reflections to determine the level of agreement among raters through tests of interrater reliability. Furthermore, comparisons of scores were conducted to determine whether the

differences in the two sets of reflections were statistically different. It is my aim to submit this chapter for possible publication in an academic journal. As before, I was the lead researcher and author, and Prof. Paez provided direction, training, and support with data analysis.

Chapter 5

Chapter 5 concludes this thesis. Here, the reader will find a concise summary of the findings from the research presented, a compilation of all recommended next steps for future research included in Chapters 2, 3, and 4, as well as some of my most recent thoughts and insights for possible future direction given our present move to teaching in online-only formats.

Concluding notes: caveat lector

The reader will note that the research presented in this thesis evolves throughout each chapter in what I hope is a logical fashion. At the same time, since each substantive chapter (Chapters 2-4) was prepared as a stand-alone manuscript for journals, there is an inevitable amount of redundancy as it relates to the foundational theories of experiential learning and reflection.

I trust that the reader will see in this thesis evidence of my passion for teaching and learning. With respect to reflection, it will not surprise readers that I am a reflective practitioner and a lifelong learner. In some ways parting from the thesis, I intend to demonstrate my reflexivity as a researcher while offering a level of relatedness to the reader, who most likely shares in common at least one of the roles that I have experienced in my professional life in academia. As such, I provide with insights into my own journey of experiential learning, which I hope will add to the demonstrated academic rigour of this thesis. These insights appear as short interludes at the beginning of each chapter. By sharing my own reflections, I aim to take readers

behind the scenes and bring them along with me to parts of the journey of inquiry that this thesis chronicles. While these interludes are meant to be a hopefully enjoyable complement to the academic papers, reflexivity is in fact an important part in ensuring methodological rigour of qualitative research. Barrett, Kajamaa, & Johnston (2020), describe reflexivity as "a continual process of engaging with and articulating the place of the researcher and the context of the research" (p. 9) Specifically, the authors describe the importance of keeping a "reflexive research diary", "meet[ing] regularly with team members for reflexive discussion", and "telling the 'story'" including reference to the researcher's positionality (Barrett et al., 2020. p. 11). These practices were an integral part of my research and my journey, and it is my hope that they will provide additional insight into the development of this thesis.

Introduction to Chapter 2

Reflection: It occurred to me then and there, in the summer of 2012 as I began the creation of my very first course syllabus. It was only a draft. I would eventually hire an instructor to teach the course and they would be responsible for creating the syllabus that would actually be used. However, that is not how I learn, and I needed to learn about this world of academia. I knew that course learning objectives, the list of items that come after the phrase, "[b]y the end of this course, students will be able to…", had to be tied to a specific grade item. I was confident in each one, until I got to the most important one (in my opinion). It struck me that I had no way of evaluating (assigning a grade to) students' experiential learning. More importantly, I had no way of knowing if students would be getting the deep, transformational learning that I was ambitiously hoping for and pursuing.

Chapter 2: Development of a New Framework to Guide, Assess, and Evaluate Student Reflections in a University Sustainability Course

This Chapter is based on the following journal paper, with some light editing for consistency with the rest of the thesis.

Abstract

Many institutions of higher education increasingly place a focus on various forms of experiential education, including personal reflections. While much work has been done in this and related areas, the resources currently available are not sufficient to effectively guide, assess, and evaluate student learning through reflection. Guiding students through the process, assessing their work, and providing an evaluation presents challenges for educators. This article discusses a new framework, a robust rubric, and a guide that students and evaluators can use to support experiential learning through reflection. The framework and resources are based on a grounded investigation of student reflections that were compared to various models from the literature. The resources discussed in the article were developed over a period of five years and with more than 1,600 students. Our purpose here is to ***describe the development of this framework, to provide a description of the rubric and guide, and to share the lessons learned.*** This framework and accompanying materials will, we hope, be a useful resource for educators and students wishing to support experiential learning through the use of reflection.

Introduction

Most people likely understand the role of experience in the learning process in an intuitive way. Learning through experimentation, stumbling upon a great idea while participating in a new activity, or reflecting on the consequences of a mistake are surely universal experiences. That said, it should be noted that experiential learning is not necessarily a direct result of experiential education. Experiential education "is the philosophical process that guides the development of structural and functional learning experiences," while experiential learning "refers to the specific techniques or mechanisms that an individual can implement to acquire knowledge or meet learning goals" (Higher Education Quality Council of Ontario, 2016 p. 18, referencing J. W. Roberts [2012], *Beyond learning by doing: Theoretical currents in experiential education*). Because of its relevance to education, the role of experience in the learning process has long been of interest, and has been addressed by researchers that include, among others, John Dewey, Kurt Lewin, and Jean Piaget (see Higher Education Quality Council of Ontario, 2016; Kolb, 2015). The body of knowledge on this topic is extensive, and covers learning styles, intrinsic versus extrinsic motivation, and surface versus deep learning, as well as tools and techniques for educators, including community-based learning, problem-based learning, and reflective writing.

The objective of this article is *to present the development of a framework and associated resources that can be used to effectively support high-quality reflection through guidance, assessment, and evaluation*. The framework, rubric, and guide are the outcome of several years of design and testing as part of a set of university-level interdisciplinary courses on the topic of

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sustainability. As of April 2018, the framework, guide, and rubric have been used in more than 18 classes and with more than 1,600 students. These materials have now been used by instructors in several faculties at McMaster University and by professionals in other fields. Their feedback has been valuable to refine both the framework and resources, so that they are now in a polished form ready for wider dissemination.

The Role of Reflection in Experiential Learning

It is widely agreed that experience plays an important role in learning (Higher Education Quality Council of Ontario, 2016; Kolb, 2015). According to the Association for Experiential Education (2019), "experiential learning occurs when carefully chosen experiences are supported by reflection, critical analysis, and synthesis." Mezirow and associates explain that "critical thinking is informed by reflection" and use it synonymously with "reflective learning," stating that "[a]lthough it is possible to think without either reflecting or learning, thought that involves critical reflection involves learning" (1990, p. xvii). Thus, while critical thinking is a function of cognition, reflection is a function of metacognition and encouraging it is one of the desired outcomes of reflection (Moon 2006). Anderson and Krathwohl (2001, p. 43) describe the two important aspects of metacognition: "(1) knowledge about cognition and (2) control, monitoring, and regulation of cognitive process." Kuiper and Pesut (2004, p. 384) suggest that "critical thinking is to cognitive skill acquisition as reflective thinking is to metacognitive skills acquisition." This implies that just thinking or having an experience do not necessarily result in learning, but rather critical thinking and reflection support and facilitate the learning process. Although Mezirow (1998) makes the distinction between "reflection" and "critical reflection" in that reflection is looking back on an experience but not necessarily making an assessment of what is being reflected upon, we use the term *reflection* to imply critical reflection.

The use of reflection in the learning process has been studied in a variety of fields, including health (Mann, Gordon, & MacLeod, 2009), professional practice (Schön, 1987), professional development (Moon, 1999), the arts (Leijen, Lam, Woldschut, & Simons, 2009), and more. Jennifer Moon mentions that "[o]ne of the difficulties of studying the literature on reflection is that it emanates from many different sources" (1999, p. vii), and she highlights some that have attempted to transcend disciplinary boundaries, including Boud, Keogh and Walker (1985), and Mezirow (1990) among others.

Although reflection has been studied from many different perspectives, they all have in common a desire to help learners to better develop knowledge, skills, and abilities. Moon (2006) places emphasis on the role of reflection in learning by identifying some purposes for learning journals, which include "to record experience" (p. 44), "to facilitate learning from experience" (p. 45), "to develop critical thinking skills or the development of a questioning attitude" (p. 46), "to encourage metacognition" (p. 46), "to enhance problem-solving skills" (p. 47), "as a means of assessment in formal education" (p. 47), "to enhance reflective practice" (p. 48), "to enhance creativity" (p. 49), and "as a means of communication between one learning and another" (p. 51). Boud (2001, p. 9) states that journal writing can be a record of events, a form of self-expression, and even a form of therapy. He presents journal writing as "a device for working with events and experiences in order to extract meaning from them," in order to "make sense of the world and how we operate within it." He also explains that "[a]s a vehicle for learning, [reflection] can be used in formal courses . . . professional practice or any aspect of informal learning" (p. 9). Schön (1987) believes that "education for reflective practice, though not a sufficient condition for wise or moral practice, is certainly a necessary one" (p. xiii). Mezirow (1998) introduces critical reflection of an assumption and critical self-reflection of an

assumption, which can have an impact on one's frame of reference and result in transformational change for the individual.

Moon offers a perspective that "most writers on reflection begin their articles with a preamble that refers to one or two of four writers whose work or models have influenced the manner in which the term is viewed . . . As to which of these writers is chosen usually depends on the angle the writer is taking" (2006, p. 11). For this article, we refer to John Dewey and David Kolb because we discuss the process of reflection based on experience as a form of education and learning. Thanks in large part to the works of Dewey and Kolb, it is widely accepted that experiences form the basis for reflections which in turn can lead to new ideas, new experiences, and learning (see, among others, Boud, 2001; Kolb & Kolb, 2009; Kolb, 2015; Moon, 1999). Through this cyclical process, ideas are formed and re-formed as learning continues (Kolb & Kolb, 2009). In *Experiential Learning Theory* and the appropriately titled *The Experiential Learning Cycle*, David Kolb (2015) places the act of reflection as the first step towards drawing meaning from an experience, which helps guide the learner to establish new ideas and to engage in new learning experiences. See the experiential learning cycle in Figure 1 (adapted from Figure 2.5 in Kolb, 2015 p. 51).

Previous work has raised the level of awareness of the role and benefits of experience and reflection within the learning process. Recently, for instance, there have been both theoretical works that develop frameworks for reflection, and explorations of the necessary conditions for quality reflection (Higher Education Quality Council of Ontario, 2016, referencing R. R. Rogers [2001], Reflection in higher education: A concept analysis). Mann, Gordon, and MacLeod (2009) reviewed and synthesized 29 studies of reflective practice in the health professions alone

and found several examples of approaches to assess reflective thinking. Highlighting the many

ideas that are available to assess learning journals, Moon (2006) provides reference to and a brief

description of a handful of examples that can be considered in the development of one's own

assessment criteria. Mezirow (1998), after presenting the significance of critical reflection of an

assumption and variations on how it is used for different purposes and for different applications

in adult education, concludes by stating that "[t]he professional task ahead is to find ways to

translate the concept of C[ritical] R[reflection] of A[ssumption] and discourse into curricula or

programs, instructional methods, materials development, and evaluation criteria" (p. 197). While

there are a number of models of reflection, there is still limited information about how to

effectively apply these theories in practice. There is agreement that reflection is best when it is

taught and guided by an educator (Moon, 1999; Russell, 2005; Ryan, 2013). Parting from

Mezirow's signal of the professional task ahead, significant opportunity exists in the ability for

educators to have a deep understanding of reflection and to be able to effectively teach and guide

students through the reflective process.
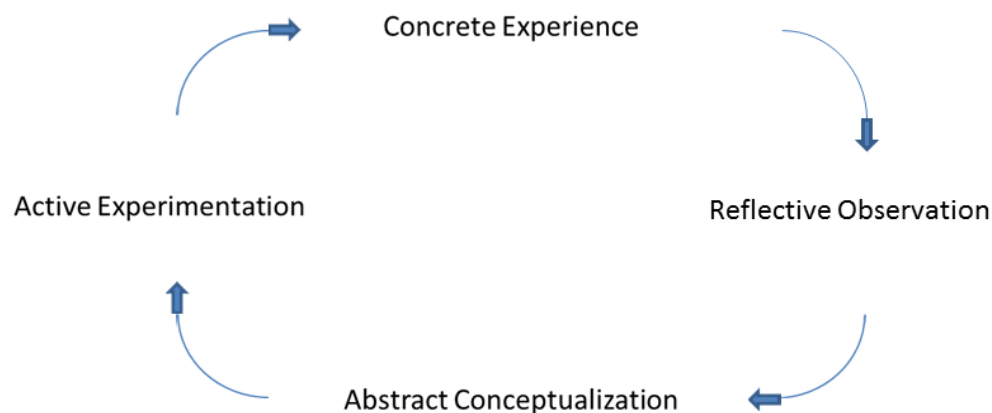
Figure 1. The experiential learning cycle

Research Context

Education is a priority of governments at various levels and within many jurisdictions. The Canadian federal government, for example, has committed to creating more jobs and greater opportunities for young Canadians. This commitment includes greater use of experiential learning, with an annual budget of $40 million (CAD) to help employers create more co-op placements for students (Liberal Party of Canada, 2015). Likewise, the province of Ontario has emphasized the importance of experiential learning to help develop a highly skilled workforce. A 2016 report, *The Premier's Highly Skilled Workforce Expert Panel* provides four key recommendations for the province, which included the expansion of experiential learning opportunities. Specifically, the report recommends that "every student has at least one experiential learning opportunity by the time they graduate from post-secondary education" (p. 27). As the discussions at the national and provincial levels were had in consultation with educational institutions, these recommendations are aligned well with the goals of colleges and universities. Progress in this area is notable. According to the Higher Education Quality Council of Ontario (2016), about half of all students now have an opportunity for experiential learning before graduation. In response to a call from the Ministry of Training Colleges and Universities (now the Ministry of Advanced Education and Skills Development), all institutions of higher education in Ontario have prepared a strategic mandate agreement outlining their areas of focus. McMaster is one of many institutions to include goals of improved learning experience and career preparedness through experiential opportunities (McMaster University, 2014). While commendable, there are inherent difficulties involved in measuring success when it comes to experiential learning. Indeed, as indicated in the agreement, current metrics of success, such as "the percentage of courses that include experiential learning opportunities" (McMaster

University 2014, p. 5), are about delivery of opportunities, but not about their impact on learning. To reiterate, providing the opportunity for learning does not guarantee that learning actually happens. Prior to being able to measure such results at the institutional level, instructors must first have effective tools to guide, assess, and evaluate experiential learning at the student level. This research was developed to attend to these needs.

Given the relative scarcity of information on best practices for guiding, assessing, and evaluating learning through experience, the initial stage of the research followed a grounded theoretical approach, and it involved the analysis and coding of student reflections taken from a level-two environmental issues course. The findings from this initial stage, complemented with a review and comparison of the literature on the topics of experiential learning and guided reflection, led to the creation of the Reflective Learning Framework.

The Reflective Learning Framework was used in four different academic courses at McMaster from 2013 through 2017 and the Winter semester of 2018. The courses selected for testing are all part of McMaster's Sustainable Future Program, or SUSTAIN, courses. This program is an ideal setting for research on experiential learning, given its mission to "inspire in all students a desire for continued learning and inquiry through experiential education" (https://asp.mcmaster.ca/). The program provides opportunities for interdisciplinary, student-led, community-based, and experiential education focused on sustainability, and thus ample opportunity for the use of reflection-based techniques.

Methods

With the objective to develop a framework for guiding, assessing, and evaluating student reflection that could be effectively used in practice, we employed grounded theory research

methodology (see Corbin & Strauss, 1990).

In line with grounded theory approach, the first set of data was a sample of university-level student reflections. Through free-form "open coding" the data were broken down analytically and given conceptual labels. Similar events were grouped to form categories that helped generate questions and inform further analysis. Through the next phase of "axial coding", the categories were tested against the data over and over again. This rigourous and systematic process is integral to the process of grounded theory. Corbin and Strauss (1990, p. 13) describe that "a single incident is not a sufficient basis to discard or verify a hypothesis. To be verified (that is, regarded as increasingly plausible) a hypothesis must be indicated by the data over and over again." The third phase of coding, known as "selective coding," "core" categories were identified and were then compared to existing theoretical models of guided reflection.

Further testing and refinement took place, which led to the development of the first iteration of the Reflective Learning Framework. Following this, and after having identified the need to compare the framework to cognitive processes involved in learning, the categories were compared to Bloom's Taxonomy for learning, teaching, and assessing (Anderson & Krathwohl, 2001), upon recommendation from a colleague. Testing and further refinement of the framework took place.

The resulting resources could then be used to facilitate knowledge transfer, and support instructors, teaching assistants, and students in the use of reflection-based techniques. Specifically, the guide provides a concise overview of the justification of each reflection component, and supports the guidance, assessment, and evaluation of student reflections. As stated, the guide is also intended for use by students. In this capacity, it provides direction as they

reflect, and can be used for self-assessment and evaluation. The framework, resources, and process for use were continually reviewed by students and educators and were refined based on their inputs. Reviewers have included teaching assistants in the SUSTAIN courses; undergraduate and graduate students at McMaster; academics; a wide range of educators, both within McMaster and elsewhere; and finally, three anonymous reviewers who read an earlier version of this article. Student comments are included here to illustrate the kind of feedback received from them. All student comments were obtained from university-administered course evaluations and were taken from one of four open ended questions: (1) "Please comment on the quality of the TAs in this course"; (2) "Please list aspects of this course that you found valuable and should be continued"; (3) "Please list aspects of this course that might be improved"; and (4) "Additional comments."

While the process may seem like a "chicken and egg" situation, the sections that follow include an overview of the stages of development of the Reflective Learning Framework and offer additional clarity of how the current version of the framework came to be. A summary of this process appears in Table 1, is followed by a full description of the key stages and then a section on lessons learned and suggestions for use. The framework and associated resources are available at https://asp.mcmaster.ca/resources.

Table 1. Developing the Reflective Learning Framework

TIMELINE	PROCESS	PROCESS DESCRIPTION
Exploration through reading student reflections		
Winter 2012	Pre-investigation	Level-two students complete lifestyle project reflection assignments for a class on environmental issues.

Early Summer 2013	Exploration and testing through open coding and axial coding	Anonymized lifestyle project reflections were given to the first author for exploratory analysis and testing, specifically to determine which components stood out as contributing to a high-quality reflection.
Review, assessment, and testing of theoretical models from the literature		
Mid-summer 2013	Literature review and testing using selective coding	Using the selected codes from the previous phases, theoretical models from the literature were reviewed and assessed for applicability. The framework by Ryan (2011) was identified as the most applicable to findings from the exploration phase. Ryan's framework was tested against the lifestyle project reflections, but challenges were identified.
Version 1.0 development through informal testing		
Late Summer 2013	Development and testing of version 1.0	Building on Ryan's structure, additional components were included to provide greater support to students and instructors. The framework was also used to create a draft evaluation rubric. The evaluation framework was then tested on a sample of the lifestyle project reflections. After some refinement, it became the first version of the framework and was taken forward for consultation and feedback.
Version 1.0 development through piloting, formal testing, and consultation		
Fall 2013	Piloting version 1.0	The framework 1.0 was piloted in a level-three sustainability class of 36 students with good success. However, there was only one reflection, which took place during the exam period, which we learned was not ideal.

Winter 2014	Formal testing of version 1.0	Version 1.0 was further piloted in a level-two sustainability class. A total of 126 students were enrolled in the course and 26 students chose to take part in the initial study, which included three reflections during the course. While the framework was an effective tool, the process for using it to guide and assess reflective writing proved to be challenging.
Winter 2014	Consultation and inspiration for the version 2.0	Through consultation with educators came a recommendation to align the framework with Bloom's Taxonomy. During this alignment, some additional revisions were made that also added clarity to the framework.
Development of version 2.0 and establishing an effective process for using the framework		
Early Summer 2014	Aligning the framework with Bloom's Taxonomy	Following the recommendations provided, the framework was revised to align with Bloom's Taxonomy, which was major evolution, warranting a version 2.0.
Summer 2014	Refining the process for using version 2.0	Study findings were further assessed and more consultation took place with students, faculty, and staff. At this stage, only minor revisions were made to the framework. However, significant revisions were made to the process for introducing the framework and using it to guide students in the reflective process.
Additional testing and refinement of the framework and process for use		
Fall 2014 to Winter 2016	Piloting the new process for using	While piloting the new process for using the framework, the first author worked closely with the instructional teams to obtain feedback on introducing the framework, supporting

	version 2.0	students through the reflective process, providing support along the way, as well as assessing and evaluating the reflection assignments.
Fall 2016 and Winter 2017	Testing the new process for using version 2.0	Version 2.0 and new process for use was tested in three separate sustainability courses. Of the total 239 students enrolled, 100 agreed to participate in the study. Feedback from the instructional team confirmed success in facilitating the new process for using the framework. Student reflections demonstrate that they have a good understanding of the framework and are able to use it to produce high-quality reflections.
Summer 2017	Documenting the process	The process of developing and using the framework as well as lessons learned were documented in a working manuscript.
Winter 2017	Anonymous reviewer feedback	The refined manuscript was submitted for review. With additional feedback from anonymous reviewers and then from members of the instructional teams, the framework was refined and currently stands as version 2.2

Development of the Reflective Learning Framework

As described in the preceding section, development of the Reflective Learning Framework was informed by (1) an analysis of university-level student reflections, (2) comparison to previous models for guided reflection, (3) comparison to Bloom's Taxonomy for learning, teaching, and assessing, and (4) continuous testing and refinement. Each of these elements is described in detail below.

Exploration through reading student reflections

Prior to the development of the Reflective Learning Framework, an analysis of student

reflections was conducted by the first author. During the Winter semester of 2012, a total of 350

level-two students enrolled in an undergraduate-level course, *Introduction to Environmental*

Issues and took part in a personal lifestyle challenge, which was based on The Lifestyle Project

of Kirk and Thomas (2003). Through this project, students had the opportunity to learn about

their impact on the environment by engaging in a three-week, self-directed, lifestyle change

challenge. Students could choose from a list of categories, such as garbage, electricity, or leave

the car at home, and kept a journal to record their experiences. Throughout the course, three

reflections were submitted for evaluation. A sample of these reflections, which were void of all

personally identifiable information, were offered to the first author to support them in gaining a

preliminary understanding of student reflections that were loosely guided and based on the

students' personal experience. These reflections provided the initial data for exploratory analysis,

but still without a formal framework for the research.

In order to more effectively guide this initial analysis, we turned to grounded theory. In

line with procedures of grounded theory, the goal at this point was to gain a better understanding

of the general components that contribute to a high-quality reflection. Identification of these

components could then be further refined and eventually used to address two key challenges: (1)

how to support students to learn about and practice reflection, and (2) how to effectively assess

and evaluate learning demonstrated through reflection. In informal discussions with instructors,

it was often stated that "you just know a good reflection when you read it." This is also

mentioned in the teaching resources provided by developers of The Lifestyle Project (see

Carleton College 2019), whereby the difficulties of assigning "a numerical grade for something

so subjective" are mentioned. Suggested criteria for grading lifestyle project reflections include effort, depth of descriptions, sincerity, and commitment. These challenges are understandable and indicate that a certain level of subjectivity in evaluating reflections is perhaps unavoidable. However, in an academic setting that may include multiple evaluators (concurrently or over time), and where grades hold substantial weight for individual students, instructors face the need to be more prescriptive and intentional in guiding, assessing, and evaluating student reflections. More information on the topic of evaluation can be found in the section on lessons learned.

This initial exploration involved reading reflections and highlighting components that *seemed* to contribute to a high-quality reflection. Initial trends that emerged included effectively describing the relevant aspects of their experience; thinking deeply about and analysing key aspects of their experience; discussing their initial thoughts and feelings, and how they may have changed; including the impact and/or influence of others; and clearly communicating their learning by providing examples. The outcome of this initial exploration through reading and analyzing a selection of more than 100 student lifestyle project reflections, finding trends, and systematically coding and categorizing the data helped to suggest which components contribute to a high-quality reflection. This process then provided the basis to generate a hypothesis and formulate questions. Three of the main questions that arose were (1) Is it enough to know which components contribute to a high-quality reflection? (2) If we gave students a list of criteria, would they be able to effectively complete a high-quality written reflection? (3) Are there frameworks that already exist that could be assessed and evaluated for use, based on the findings from the initial analysis in this study?

Review, assessment, and testing of theoretical models from the literature

At this point, we detected the need for a framework to use in our courses. While we anticipated having to create our own, we were curious to see if there was one that already existed that could be adopted or modified to suit our needs. Armed with the components and findings identified in the preceding stage, the next stage was to conduct a review of the literature up to the date and identify relevant theoretical models to guide, assess, and evaluate reflections. A number of models were identified, compared, and contrasted (Boud, 2001; Grossman, 2009; Kember, McKay, Sinclair, & Wong, 2008; Leijen, Valtna, Leijen, & Pedaste, 2012; Ryan, 2011). The codes and categories identified through grounded theory were compared and contrasted to the above theoretical models.

It was found that some models were impractical for large course settings, lacked concrete descriptions, and/or did not lend themselves well to assessment of knowledge. Because the initial exploration focused on identifying components from written work that seemed to contribute to a high-quality reflection, the framework that was found to most closely align with the findings from the exploratory analysis was Ryan's (2011) structure for reflective writing in higher education. This structure included four text types as well as a description of the associated elements that should be evident in academic reflection. Table 2 presents Ryan's base structure (adapted from Table 1 in Ryan, 2011, p. 104). It should be noted that Ryan took the base structure further to include specific text structure and linguistic resources. However, Ryan's base structure was of primary value to the development of the Reflective Learning Framework at this point, due to its ability to assess all identified components of a high-quality reflection, the level of detail provided to explain the various components, and its suitability to assess learning.

This framework was tested to determine if it could be effectively used to assess and assign a value to the sample of student lifestyle project reflections. However, its use revealed challenges related to consistency and ease of use. For example, the discussion component of Ryan's framework states that the student "hypothesises about different possible responses, actions and future practices" (2001, p. 104). In practice, these items were often present in reflections, but in various levels of quality. More generally, it was found that blind assessments of the same reflection multiple days apart resulted in different grades: the lack of explicit criteria, it seems, *can lead evaluators to create structure* through identifying additional criteria to support evaluation, and these criteria could vary by instructor or even the same instructor at different points in time. Thus, while Ryan's framework offered the greatest amount of detail among those considered at the time, it was still not sufficient for an evaluator to reliably and systematically identify evidence of learning within the reflections. Furthermore, if such challenges were faced by an evaluator, they would most certainly be faced by the students as well.

For the above reason, a more robust structure was required to support guidance, assessment, and evaluation, by identifying, providing information about, and describing relevance for individual criteria in the framework. Such structure would ideally support recognition and assessment of each criterion, both by students and evaluators.

Table 2. Text types in an academic reflection

TEXT TYPE	ELEMENTS EVIDENT IN ACADEMIC REFLECTION
Recount	An experience or event is retold using temporal indicators, thoughts, and initial reactions
Description	Technical vocabulary of the discipline is used to describe the event,

	compare/contrast to other similar events or experiences
Explanation	Evidence, appraisal resources and cause/effect indicators are used to reason and explain how and why the event happened the way it did
Discussion	Hypothesise about different possible responses, actions and future practices

Version 1.0: Development through informal testing

A new framework was developed from Ryan's framework, by using the core categories that had been previously created, as well as information obtained from other theoretical models from the literature. This framework underwent extensive informal testing before being piloted in an academic course. This testing included assessment and evaluation of a sample of student lifestyle project reflections, the first author writing new sample reflections using the Reflective Learning Framework rubric and guide, as well as some consultation with other educators with experience in course-based reflections. Version 1.0 included the following three categories and 10 components:

Recount

- effectively and clearly re-tells the story

- states initial thoughts and/or reactions

- makes reference to feelings

Description and Explanation

- uses terms, vocabulary, or concepts from the course or of the discipline

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- provides evidence using references

- shows evidence of evaluating cause-and-effect of events

Discussion

- shows thinking about other possible responses and/or questions the status quo

- discusses future plans

- relates the experience to other contexts in life

- draws connections between the broader local and/or global context

We also developed the first draft of the guide to the framework to provide more information about each component. We were confident that these resources would be useful for students and educators, but we did not assume that they were a finished product. The framework was still simply a list of components with only limited explanation about each one's importance to learning. Furthermore, at a more practical level, three categories and 10 components were a lot to manage. As an evaluator, it was difficult to recall all 10 components without having to continually reference the framework.

Version 1.0: Development through piloting, formal testing, and consultation

In the fall of 2013, version 1.0 was piloted in a level-three sustainability course with 36 students. In this course, students learn about sustainability theory through readings, lectures, and tutorials. Their major project involved working in interdisciplinary teams to tackle a real-world sustainability challenge with the support of a community partner. The students completed one reflection assignment, which was worth 10 percent of their grade and took place during the exam period. Through dialogue with members of the instructional team, we felt like we had good

success. However, because students only had one opportunity to reflect and because that opportunity took place after the course was over, we learned that including a reflection assignment so late in the term was a missed opportunity for learning. In the words of one student, "The emphasis on reflection on the course content, particularly for the final project is extremely important and I see great relevance in it! I think greater emphasis should be focused on reflecting periodically during the semester by potentially allocating some time during the tutorial or lecture to give us some time to think and reflect." (Student, SUSTAIN 3A03, Fall 2013)

This lesson enabled us to revise the course to encourage and support ongoing reflection during the semester and to include two reflections each term, whenever we had the time and teaching resources available to do so. We then launched a formal study with student participants during the level-two sustainability course, which was offered the following term. The major project in this course consists of a self-directed lifestyle challenge where the students aim to reduce their personal impact on the environment and/or enhance their impact on society. A total of 126 students were enrolled in the course and 26 agreed to take part in the study by completing three short surveys and allowing us to use their reflections for research. A key takeaway at this stage was that students experience a level of anxiety about reflection stemming from their uncertainty about how to approach it and/or how it will be evaluated. It was hypothesized that providing more information and guidance to students early on as well as making the process as easy and straight forward as possible would make the process more enjoyable and may also result in higher quality reflections and, therefore, deeper learning. Comments regarding the need for additional guidance included the following:

Teach us how to write a structured reflection—this would also help us in other classes (Student, SUSTAIN 3A03, Fall 2013)

I also liked the reflections, although they were a bit confusing and weren't as reflection-like as other reflections that I had done, in the way that there was kind of a mould we had to follow . . . which seems counterintuitive when we're reflecting on our experiences. (Student, SUSTAIN 2A03, Winter 2014)

[A] class on how to write a reflective piece [and a] grant proposal would have been greatly appreciated (Student, SUSTAIN 2A03, Winter 2014)

Throughout this time, discussion with educators who were experienced with course-based reflections also took place. During these discussions, a recommendation was made to align the Reflective Learning Framework with Bloom's Taxonomy, which was then scheduled to take place over the summer months.

Developing version 2.0 and establishing an effective process for using the framework

Aligning the framework with Bloom's Taxonomy was a key turning point in the evolution from 1.0 to 2.0. Working with Bloom's Taxonomy offered support to ensure all knowledge dimensions (factual, conceptual, procedural, and metacognitive) and cognitive process dimensions (*remember*, *understand*, *apply*, *analyze*, *evaluate*, and *create*) were considered and properly aligned with the framework. Additionally, working within a pre-defined hierarchy and widely accepted framework offered a legitimate way to effectively assess and evaluate learning as well as to more effectively communicate the desired outcomes to the students. Specifically, the major revision for version 2.0 was the creation of two or three specific criteria associated with each component of the framework and its alignment of each criterion with the cognitive processes and knowledge dimensions outlined in Bloom's Taxonomy.

This revision helped to remove uncertainty by focusing on cognitive skills demonstrated through reflection. Furthermore, Bloom's Taxonomy also addresses the need for institutions to measure and report program-level learning outcomes by enabling instructors to measure and report on course-level learning outcomes (Higher Education Quality Council of Ontario, 2015). In this respect, Bloom's Taxonomy has been considered by many to be the gold standard for developing cognitive process-aligned learning outcomes (Anderson & Krathwohl 2001). It is important to note that one of the criticisms of Bloom's Taxonomy is the focus on the cognitive domain, without much attention to the psychomotor and, in particular, the affective domain. Much agreement exists in the importance of affect in learning (Boyle et al., 2007; Kolb & Kolb, 2005; Littledyke, 2008; Sinatra & Pintrich, 2003). Anderson and Krathwohl (2001, pp. 258–259) address the criticism by stating that, "[the] decision has been justly criticized because it isolates aspects of the same objective—and nearly every cognitive objective has an affective component…By intentionally focusing on the cognitive domain, this revision ignores this problem except for the fact, as noted earlier, that the *Metacognitive Knowledge* category in some respects bridges the cognitive and affective domains." The connection between the cognitive domain and the affective domain can be easily described, in the succinct words of one student: "I found the lifestyle reflection and the reflection assignments really fun. When they are more fun you absorb more information" (Student, SUSTAIN 2S03, Winter 2016)

In addition, as alluded to above, Bloom's Taxonomy, which was first published in 1956, underwent a major revision in the late 1990s (Anderson & Krathwohl 2001). In the earlier version, there were only three knowledge dimensions: factual, conceptual, and procedural. An important aspect of the revised version is the inclusion of the fourth knowledge dimension, metacognitive knowledge. Metacognitive knowledge is the "knowledge about cognition in

general as well as awareness of and knowledge about one's own cognition" (Anderson & Krathwohl, 2001, p. 27). As described above, while critical thinking is a function of cognition, reflection is a function of metacognition. This addition to Bloom's Taxonomy has been critical for the creation of version 2.0. Given the essentially metacognitive nature of reflection and because it bridges the gap between cognitive and affective domains, appropriate comparisons between Bloom's Taxonomy and the reflection data would not have otherwise been possible. Following alignment with Bloom's Taxonomy, version 2.0 was further reduced two major categories and eight components. Furthermore, and to allow for scaffolding of reflection skills, each of the eight components were amended with additional levels of depth and detail that would support higher learning through reflection. For example, one component in the version 2.0 encourages students to reference their *personal thoughts and feelings*. However, by specifying additional criteria connected to Bloom's Taxonomy, students are guided to *analyze their personal points of view, biases, values, and intensions*, thus further enhancing their reflection. Before aligning the framework with Bloom's Taxonomy many minor revisions were made. However this alignment called for a distinction from the earlier iteration. As such, we refer to the new version as 2.0, which also came complete with a guide, rubric, and sample evaluated reflection. Once version 2.0 was developed, we also invested time in refining the process for how it was introduced to students and how it was used to help guide them through the process. Attention was given to when and how students were introduced to the framework and to how feedback could be used to help students further enhance their reflection skills going forward. Additional information on this has been included in the section on lessons learned.

Additional testing and refinement of the framework and process for use

Between the Fall of 2014 and the Winter of 2016, the Reflective Learning Framework and process for use were further refined through experiences using it in three sustainability courses, a level-one, a level-two, and a level-three class. There were lessons learned during this time that led to minor revisions of the framework and its use. We found that two reflection assignments taking place during the course was ideal, as it offered students the opportunity to develop their skills but without putting too much of a strain on educators. A student in the level-one course explained, "I liked how we got to do two reflections and two group assignments this allowed for us to receive feedback and use that feedback to improve on our work. If we did not have two assignments, I feel as if I would not have looked over my first assignment as much. Reviewing your work is a great way to improve yourself academically" (Student, SUSTAIN 1S03, Fall 2015).

With respect to the process for introduction and guidance, we found that making students aware of the reflection assignment and the framework early in the term is helpful for those students who are eager to learn more or to get a head start. The instructor and/or teaching assistant discuss the assignment and make reference to the framework while reviewing the course syllabus during the first class. The Reflective Learning Framework is also made available to students on the course website. A short formal introduction the framework takes place during tutorial about two weeks before the due date for the first of two reflection assignments. This is found to be effective because the students are conscious that the assignment is approaching.

Once the first reflections are assessed and handed back to students with feedback, a second tutorial on reflection takes place. Students are asked to review the feedback given by their

teaching assistant and to come to tutorial prepared with questions. During the tutorial, students

engage in an activity to help unpack the framework and enhance their understanding of the

reflection assignment. They are given two sheets of paper—one with a sample reflection and the

other with a list of the eight reflection components and a short description of each. Students

spend about 10 minutes on their own trying to match the reflection components to text in the

sample reflection. Basically, we are asking students to test their knowledge by evaluating the

sample reflection using the Reflective Learning Framework.

From our experience, there are two components that are most commonly missed in student

reflections, *cause-and-effect relationships* and *planning and future practices*. Our hypothesis is

that *cause-and-effect relationships* is the component most difficult to understand simply by

reading the Reflective Learning Framework and *planning and future practices* is not often

considered because people tend to think of reflection as only looking back rather than looking

ahead. For these two components, we intentionally omit them from the sample reflection and

instead ask students to put themselves in the author's position and create a few sentences on how

they might satisfy each of those two components. Students then share their answers with a peer

before the teaching assistant takes up the activity and facilitates a class discussion. These

tutorials are lively with discussion and seem to support students' understanding of the Reflective

Learning Framework. In the words of one student, "I also really appreciated that we did the

reflection activity in tutorial after we handed in the first reflection. I felt that I got more out of the

exercise by already knowing what I wrote about in my reflection and going through the

questions, rather than answering the questions and I would not have known how it would help

me in the future" (Student, SUSTAIN 1S03, Fall 2016). Following the second reflection,

students are asked to review feedback provided by their teaching assistant and to seek additional

support and/or address any concerns during pre-scheduled office hours, which again take place in advance of the exam period. Once the process for using the Reflective Learning Framework was refined, it was then appropriate to conduct additional formal research with student participation.

The original Ethics application was amended with some minor revisions to the study design and the revised framework. Three courses were used for the study, the level-one, level-two, and level-four sustainability class. As discussed, the level-three class only has one reflection assignment, and therefore it did not align with our study design. Of the total 239 students enrolled in the three courses, 100 agreed to participate in the study by providing feedback and making their reflection activity sheets and reflection assignments available for research purposes.

Through discussion with teaching assistants and instructors, the Reflective Learning Framework and refined process is proving to be an effective tool to guide, assess, and evaluate student reflections. However, further development will surely take place as we continue to learn through our experience and through consulting with others. From our experience during the most recent round of testing, we learned more about the importance of feedback. In particular, we learned about the importance of how written feedback from teaching assistants is articulated, who is providing the feedback, and how quickly feedback is given. Some examples of how students expressed this include the following:

> *It would be much more helpful if the comments on our assignments and reflections came with a rubric and useful comments so that students can understand where they went wrong in their writing. (Student, SUSTAIN 1S03, Fall 2016)*

> *However, the fact that our written reflections were marked by a different TA was very uncalled for. I am writing a reflection that caters to my TA and their style, but then I get horrible mark from a separate TA. What the heck is this nonsense? Feedback was very poor*

on my written reflections as well. I think the TA that marked my paper should be more open minded to the work they are marking. (Student, SUSTAIN 1S03, Fall 2017)

Reflection 1 feedback was given pretty close to Reflection 2 due date. If we receive feedback earlier it would allow me to take the comments into consideration and improve on my subsequent reflection. (Student, SUSTAIN 1S03, Winter 2018)

There are inherent difficulties in marking a large number of written reflections in a short amount of time, which may lead to giving more direct feedback that may come across as negative or terse. Furthermore, we identified a lack of training given to both teaching assistants and instructors, which does not seem to be unique to the department or Faculty. Furthermore, reflection assignments are highly personal and additional care must be taken to how feedback is provided. Examples from student feedback include, "Reflections were marked unnecessarily harshly, with little feedback to offer an explanation as to why the mark was so low" (Student, SUSTAIN 1S03, Fall 2015), and "I was disappointed in having to write about my feelings and were deemed 'wrong'" (Student, SUSTAIN 2A03, Winter 2014). This extends beyond the current scope of this research but has been identified as a necessary topic to address in future. Training is now offered to all teaching assistants at the Faculty level, but we have not assessed the training to determine if it addresses our concerns.

In addition to learning about the importance of feedback, we also learned that, while the supports provided to students have been welcomed and perceived positively, students do not always make their way through the framework. This can be demonstrated by student feedback: "It would be great to have a sample reflection of someone in the past to look at etc. to have a good idea. Many times I didn't know how to go about writing and what format, although the rubric was incredibly helpful" (Student, SUSTAIN 2S03, Winter 2018). The comment

demonstrates both the appreciation and usefulness of the guidance provided, but also that they did not read the entire framework. There has been a sample reflection provided in every version of the framework since its creation. However, it has always been placed near the end of the guide and it is left up to the students to read the framework on their own time. (We discuss this in greater detail in subsequent sections).

Following submission of this article for external review, valuable feedback provided by the anonymous reviewers led to meaningful enhancements to the framework. While the feedback was valuable, we were encouraged that the recommendations were relatively minor, speaking to the quality of the framework in its current state, version 2.2.

The Framework

As described above, version 1.0 was mainly based on the work of Ryan (2011) and further developed, first to address some of the challenges faced when applying it, in terms of consistency and ease of use, and later to align it with Bloom's Taxonomy. Bloom's Taxonomy helps educators categorize learning objectives, which is important for a variety of reasons, including helping educators to see the objectives from the student's point of view, to see the relationship between knowledge and cognitive processes of the learning objectives, and to see the relationship among objectives and how they are taught and how learning is assessed (Anderson & Krathwohl, 2001). Bloom's Taxonomy includes four knowledge dimensions: factual, conceptual, procedural, and metacognitive, and six categories of cognitive processes seen in Figure 2 (Vanderbilt University, 2018). The following categories of cognitive processes are listed from those that are "most commonly found in objectives" at the bottom to those that are "less frequently found in objectives" at the top (Anderson & Krathwohl, 2001, p. 30):

remember, *understand*, *apply*, *analyze*, *evaluate*, and *create*. Anderson and Krathwohl (2001)

also refer to those categories further along in the list as having a "higher level of complexity" (p.

34). Under each cognitive process category are two or more cognitive processes. For example,

the category "remember" includes two processes, recognizing and recalling, which is adapted

from Anderson & Krathwohl (2001) in Table 3 (pp. 67–68).
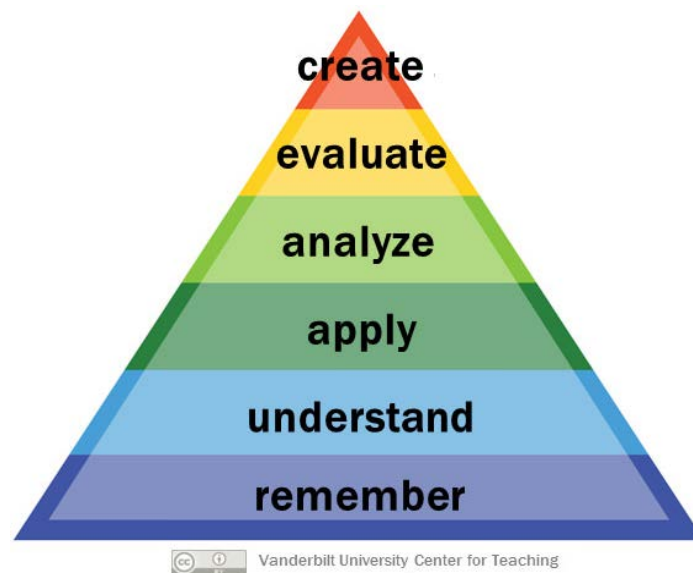
Figure 2. Cognitive process categories of Bloom's Taxonomy

Table 3. Categories and cognitive processes of Bloom's Taxonomy

Categories and Cognitive Processes of Bloom's Taxonomy
1. Remember
1.1 Recognizing 1.2 Recalling
2. Understand
2.1 Interpreting 2.2 Exemplifying 2.3 Classifying 2.4 Summarizing 2.5 Inferring 2.6 Comparing 2.7 Explaining
3. Apply
3.1 Executing 3.2 Implementing
4. Analyze
4.1 Differentiating 4.2 Organizing 4.3 Attributing
5. Evaluate
5.1 Checking 5.2 Critiquing
6. Create
6.1 Generating 6.2 Planning 6.3 Producing

The current version of the Reflective Learning Framework is broadly divided into two categories with a total of eight reflection components:

Recount

- Temporal progression

- Important aspects of the experience

- Connection to academic theory

Discussion

- Relating to Other Contexts

- Personal Thoughts and Feelings

- Cause-and-effect Relationships

- Other Possible Responses

- Planning and Future Practices

The organization of the framework is roughly based on the levels of cognition required. Each reflection component is broken down into either two or three specific criteria directly related to a cognitive process and knowledge dimension as outlined in Bloom's Taxonomy. The reflection category of Recount includes more lower-level cognitive processes, which correspond to Bloom's Taxonomy for *remember*, *understand*, and also includes *analyze*. While Bloom's Taxonomy also includes the category apply, none of the framework's components aligned with that specific category. The Discussion category includes more higher-level cognitive processes categories, which correspond to Bloom's Taxonomy for *analyze*, *evaluate*, and *create*. The cognitive process category *analyze* is included in both the Recount and Discussion categories. It is not to say that recounting requires *only* lower level cognitive processes, rather it requires more of the lower level cognitive processes in general.

When reviewing the framework, it should be evident that this division of main categories, reflection components, individual criteria, is consistent with the grounded theory process, which

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we think should support broad application for use by others. However, it is important to note that, during development of the framework, we use Bloom's Taxonomy to categorize learning objectives of the reflection activities in four related course all within a particular academic program. The objectives of the reflection activity have been largely influenced by years of study using a grounded theoretical approach. As such, if applied elsewhere, the framework may need to be revised based on the objectives of another educator and/or course. Anderson and Krathwohl describe that Bloom's Taxonomy "can be used to categorize objectives, provided that the person or persons doing the categorization make correct inferences. Because inference is involved and because each person may have access to different information, individuals may disagree about the correct classification of an objective" (2001, p. 34). As such, we encourage those looking to use the Reflective Learning Framework for their own instruction to apply their knowledge of their objectives, make their own inferences, and revise as necessary.

Lessons Learned and Suggestions for Use

The Reflective Learning Framework has been used in the Sustainable Future Program and has gone through multiple revisions and produced two main iterations, and each time the tools were used, new lessons were learned. The Sustainable Future Program is relatively new, having started with one course in the Winter 2013 semester. The university and the instructional teams, which include instructors, teaching assistants, and program administrators, are highly focused on continuous improvement at the assignment, course, and program level. Each course offering is an opportunity to proceed with data collection and analysis to identify strengths and areas for improvement. The reflection component is no exception. Learning takes place in each course and revisions in the framework or its use have taken place at least once annually. The main lessons drawn from these experiences have been distilled in the form of suggested use of the framework

and accompanying resources. The following recommendations are intended to support the use of the framework.

Tailor the framework to support the specific application

The Reflective Learning Framework has been designed while keeping in mind its general applicability. A primary goal has been to ensure that the categories, components, and criteria are general enough to be used for various applications. That being said, development and piloting of the framework as part of McMaster's Sustainable Future Program has no doubt imparted a certain flavour to it. To be effective more broadly, the framework may need modifications to suit the nature, context, and level of study for specific applications.

As an example, it is possible to note that the level of cognitive processing required increases with each reflection component. For instance, "important aspects of the experience" requires a higher level of cognitive processing than "temporal progression", and so on. As such, the associated marks for evaluation are higher for discussion components and lower for recount components. For ease of use, each discussion component was given a value of 6 and each recount component was given a value of 3. Instructors may choose to value each component differently, based on various aspects such as the instructional goals for the course or students' prior knowledge.

Share the framework, guide, and rubric with students

Sharing the framework and resources with students can support self- and peer-evaluation, as well as help to clarify expectations. Posting the framework and resources online and including details within the course syllabus are good opportunities to share these resources with students early on

in the course. Findings by Andrade (2001) show how sharing instructional rubrics with students helps them to understand and identify qualities of good work, supports them in producing good work, and is a key part in providing helpful feedback to students.

In The Sustainable Future Program, in addition to sharing the resources with students online, a teaching assistant is instructed to deliver a tutorial on reflection approximately two weeks before the first reflection assignment is due. This timing is close enough so that students have started thinking about their reflection, but still provides ample time to offer early guidance about expectations. This tutorial ensures that students are aware of the framework, provides a review of the framework, and encourages self- and peer-assessment.

Provide opportunities for multiple reflections

Initially, students were only given one opportunity for reflection. The reflection was due at the end of the course during exam period. As a result, students were not able to ask questions, learn from their first experience, or to develop their skills through a second application. Providing students with the opportunity to submit at least two reflections, for instance one mid-term and another at the end of the term, is recommended. Furthermore, ensuring the reflection is due and feedback can be provided before the end of the semester is also recommended to allow students to review and discuss strengths and areas for improvement. Ambrose et al. (2010, p. 141) state that "[t]he full benefits of feedback can only be realized when the feedback adequately directs students' subsequent practice *and* when students have the capacity to incorporate that feedback into further practice."

Use the framework and guide to support self- and peer-evaluation

Students are often surprised to see their reflection assignment evaluated with such rigour, and they usually have questions about their grade.

This provides an excellent opportunity to encourage students to review the guide and use the rubric to undertake a self-evaluation of their reflection to support the discussion with their instructor about how their grade was awarded. In many instances, once a student conducts a self-evaluation to identify specific areas of concern, they either find the answers on their own or they provide the opportunity for a more effective and focused discussion with the instructor. Moon promotes the use of informal peer and self-assessment on reflection work and states that "[a] learner's ability to assess or evaluate their own work is an important skill to be gained in higher learning" (1999, p. 211).

To support self- and peer-evaluation, and to further assist students in developing their reflection skills, starting in the second pilot, teaching assistants in the SUSTAIN courses are instructed to facilitate a tutorial activity approximately one week after the first reflection marks have been released to students. This has taken the form of an activity sheet where students receive a sample reflection that they must evaluate using the Reflective Learning Framework. To support individual and group learning, students receive two different coloured pens. They work individually with one colour to complete the activity sheet, and then they get into pairs to discuss their responses. Before the tutorial concludes, the teaching assistant reviews correct answers with the class and clarifies questions. Students use the alternate colour pen to make revisions to the activity sheet where necessary. It should be noted that this activity has been piloted in various applications: initially, the activity took place before the first reflection, and later the process was

revised so that it took place after the first reflection grades had been returned.

When the activity is facilitated after the first reflection, teaching assistants report that students are highly engaged and they receive positive response from students. A reason for this might be that students already had a previous experience with reflection and also time to reflect on the outcomes of the assignment. Consequently they are more interested and incentivised to learn and improve on the next reflection. Ambrose et al. (2010) describe how "research has shown that adding structure and support—also called *instructional scaffolding*—to a practice activity in or out of class promotes learning when it helps students practice the target skill and at appropriate level of challenge" and further connect this to "Vygotsky's Zone of Proximal Development, which defines the optimal level of challenge for a student's learning in terms of a task that the student cannot perform successfully on his or her own but could perform successfully with some help from another person or group" (p. 132). In discussing content and timing of feedback, Ambrose et al. recommend providing targeted feedback that is earlier than later and more frequent than less, in general. One primary implication to effective feedback is that it is "provided at a time and frequency when students will be most likely to use it" (p. 143).

Remove uncertainty by focusing on knowledge and skills demonstrated

During the initial pilot of the framework, the instructional team noticed a very large range in reflection grades being awarded whereby some students received failing grades while others received nearly full marks. Upon informal review, the students who received high marks had clearly consulted the framework and spent much more time and effort in completing the reflection assignment. The learning demonstrated through these reflections was of very high quality and included many examples that were found to be surprisingly insightful. However,

those reflections that received lower grades were superficial in nature and resembled a record of events that had taken place, rather than an exercise in evaluating and making meaning from their experience.

To gain perspective on this observation, we consulted other members of the instructional team who did not have a deep understanding of the framework specifically, because they were not responsible for teaching or grading the reflection assignments, but were experienced and highly respected in their educational roles. In facilitating this investigation, the instructional team participated in an activity to help increase the accuracy of grades awarded by using the framework. Seven reflections, which included a range in quality, were sent to three members of the instructional team. The reflections were void of grades and comments. The instructional team members were asked to provide a general grade for each reflection. The reflection grades provided by the selected team members were all very close to the grades awarded through the use of the framework. However, the higher grades were closer and the lower grades were further apart.

The members of the instructional team did not apply any failing grades to students. However, through using the Reflective Learning Framework, there were students who received failing grades. When prompted, the instructional team members agreed that while the poor reflections deserved a failing grade, they felt badly about giving a poor grade on an assignment that was so personal to the student author and also very subjective. However, as a result, the student was not being provided with valuable feedback or guidance on how to improve. From this, a personal, value-based challenge surfaced throughout this initial phase of the research, which stemmed from the idea that the framework was developed to evaluate something that has

personal significance to the individual student. It was difficult to justify giving a student a poor grade when they had clearly expressed deep and meaningful emotions throughout their reflection. Reflections that were eloquently written and articulated deep emotions about the student's experience were a pleasure to read and also tugged on the heartstrings. However, there were examples where eloquent and heartfelt reflections could be lacking in higher-order thinking. These examples proved to be the most challenging for an evaluator who is trying to both foster and accurately assess for deep and critical reflection.

For those instructors wanting to evaluate student reflections for grades, as we do in the Sustainable Future Program, the Reflective Learning Framework helps to remove subjectivity, offer specific guidance to students on how they can improve, and justify grades awarded. However, it is important to note that there is a case against grading student reflections. The risk of awarding a low grade to well-written, emotional, and positive reflection is that it may stifle the student's desire to continue to learn through reflection.

As an argument against formally evaluated reflections, Kaufman (2013) discusses the type of environment that would support or inhibit reflexivity, supporting "free writing" whereby students don't edit out "bad writing" or "unacceptable thoughts and feelings" (p. 73). Kaufman also supports anonymous reflections, arguing that, "[i]f students are worried about how they will be judged based on their written responses, then it is unlikely they will get to the point where they can engage in a sympathetic, yet introspective, analysis of their positions and situations" (2013, pp. 73–74). Additionally, regarding feedback provided to students, Moon states that, "[f]eedback on work can be a red slash or a helpful comment that demonstrates empathy with the work and its producer" and that, "the quality of feedback is in danger of degradation in the face

of burgeoning student numbers" (1999, p. 211).

Given this argument, some instructors may choose to take a different approach by using the framework to guide reflection but refrain from formal evaluation. Relating to the comment by Moon, instructors with large classes and without sufficient resources to guide, assess, and evaluate student reflections, may choose a different model. However, identifying this difficulty sheds light on the challenge faced by instructors when evaluating reflection assignments and provides further value for the use of the framework. This issue was addressed in version 2.0 after aligning the framework to Bloom's Taxonomy (using Anderson & Krathwohl, 2001). While it is recommended for instructors to make necessary revisions to support their specific course or purpose, ensuring a focus on knowledge and skills demonstrated to support deep and critical reflection is highly encouraged, both to help remove uncertainty and support student learning and skill development.

Summary and Future Research

After multiple years of testing and revisions to the framework, we now feel confident that the Reflective Learning Framework is a robust tool for guiding, assessing, and evaluating reflections, and is ready for broader dissemination. Given the novelty of the framework, it is clear that there are multiple avenues for future research and development. For instance, we understand that reading a formal guide about reflection is not the most attractive method available. Given the wide array of instructional resources available, there is an opportunity to translate the framework and guide into tools that are engaging, interactive, and enjoyable for both students and educators. These resources could additionally be evaluated based on the perspectives of instructors, teaching assistants, and students. By providing a detailed and

extensive set of criteria for assessing reflection, we hope that the framework will result in consistent evaluations. The question of interrater reliability, however, remains open, and a more systematic study of this issue could help us to understand to what degree we have achieved this goal. Related to the initial question of this research—does reflection as an element of experiential learning inspire a desire for continuous learning and inquiry?—additional research could include a longitudinal study of SUSTAIN students throughout their undergraduate career as well as beyond their graduating from university. This study could compare against a control group of students who had not taken part in courses that had reflection and experience. Through conducting this research and sharing the findings, we hope that educators will be provided with additional resources to guide student reflections and assess them for learning; a method for consistently assessing learning through experience, moving away from metrics on providing opportunities and towards metrics that evaluate learning; and ultimately more opportunities for experiential learning in higher education.

revisions of the framework. Finally, we acknowledge those authors who have laid the foundation for this work that has enabled us to contribute to the broader discussion.

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Introduction to Chapter 3

Reflection: I was not sure if the RLF would ever come to be the educational resource I was hoping it would be. Was I expecting too much from it? Would it stand the test of time? I wanted something that was academically robust, that could be used in practice, and that students both enjoyed and found value in. After publishing the first manuscript, I was confident in the rigour and theoretical legitimacy of the framework. However, I wanted this to be something more than a theoretical contribution to the academic literature. I wanted to create something that I could confidently share with other educators. Ultimately, I wanted it to be something that could support the mission of my department – to inspire students to continue learning through experience. It had been seven years since starting this journey, and I didn't actually know if the RLF had the desired, positive impact that I was aiming for and though initial results warranted optimism, much uncharted territory remained to be discovered. The reality was that if the students didn't like the RLF, then it didn't matter how academically robust it was because it would be unlikely that they would use it in support of their continued learning beyond the course. At best, it would be rendered a steppingstone to something different and better. Although continuous improvement is the intent either way, I wanted to develop the RLF to the point where others could more confidently apply it and build upon it. It was time for me to hear from students directly and learn from their individual and unique experiences.

Chapter 3: Student Perceptions of Reflection and the Acquisition of Higher-order Thinking Skills in a University Sustainability Course

Abstract

Sustainability challenges are complex and call for the effective development of knowledge, skills, and abilities in current and new leaders. New offerings in higher education provide sustainability training to complement studies in geography, engineering, science, and other disciplines, in many cases including innovative experiential learning components – including the use of reflection. Although reflection in education is not a new concept, how to assess reflection has remained challenging. Recent research on the Reflective Learning Framework (RLF) aims to address many of the challenges associated with guiding, assessing, and evaluating student learning through reflections. The objective of this research was to investigate the perceptions of students who use the RLF about their experience using reflection in a sustainability course. Semi-structured interviews with students provide a valuable perspective on the use of reflection. In particular, findings from this research indicate that students see reflection as a tool to develop and use cognitive and metacognitive skills, and also as a tool to support knowledge retention and transfer. Accordingly, student perspectives on reflection show that this practice contributes to the acquisition of higher-order thinking skills required to address the complex challenges of sustainability.

Keywords

Sustainability, reflection, experiential learning, Bloom's Taxonomy, metacognition, cognition

Introduction: The need to know how to tackle complex problems

Sustainability challenges are increasingly complex, and it is the responsibility of current and future generations to develop the knowledge, skills, and abilities necessary to understand and address them. On an individual level, the complexities of many of the sustainability issues we face challenge our ability to understand the causal relationship between actions and the often geographically and/or temporally distant effects they have (Mochizuki & Bryan, 2019). In addition, sustainability topics are often taught from theoretical perspectives in subject and disciplinary silos, and as a consequence, the relevant interconnections of the broader system may be missed.

Universities, as centres for the creation and dissemination of knowledge, have an important role to play in the development of capacity to tackle sustainability challenges (Delors, 1996; Ginkel, 1998; Mochizuki & Bryan, 2019; Molthan-Hill, Worsfold, Nagy, Filho, & Mifsud, 2019; UNESCO, 2005). Along these lines, four dimensions of knowledge are recognized (Anderson et al., 2001): factual; conceptual, procedural, and metacognitive. All these dimensions are important in higher education; however, while factual knowledge deals with "the basic elements students must know to be acquainted with a discipline or solve problems in it," and procedural knowledge deals with "how to do something, methods of injury, and criteria for using skills, algorithms, techniques, and methods", the complexity of sustainability means that procedures and facts are a necessary but not sufficient knowledge foundation (Anderson et al., 2001, p. 29). In contrast, conceptual knowledge deals with the "interrelationships among the

basic elements within a larger structure that enables them to function together" (Anderson et al., 2001, p. 29) and metacognitive knowledge is "knowledge of cognition in general as well as awareness and knowledge of one's own cognition" (p. 29 ibid.) – that is, precisely the kind of knowledge needed to adapt to new circumstances.

In addition, there are various cognitive or "mental" processes that individuals employ within each knowledge dimension. Anderson et al. (2001) outline six cognitive processes, with the three higher-order processes being the ability to *analyze*, *evaluate*, and *create*. *Analyze* is the ability to "break material into constituent parts and determine how parts relate to one another and to an overall structure or purpose"; *evaluate* is the ability to "make judgements based on personal criteria or standards"; and create is the ability to "put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure" (Anderson et al., 2001 p. 31). As such, the role of cognition and metacognition, as well as higher-order cognitive processes are necessary to one's ability to understand complex systems, draw relevant connections, and create solutions.

Despite the importance of higher-order cognitive processes, they are less often found in learning objectives (Anderson et al., 2001) – partly because it is perceived as requiring too much work from students and instructors (Scheyvens, Griffin, Jocoy, Liu, & Bradford, 2008), and because these approaches do not lend themselves easily to assessment and evaluation in an outcomes-driven system (Whalen & Paez, 2019). While the solutions to address the complex problems of sustainability need yet to be realized, it is unlikely that said solutions will be developed through our collective ability to remember and recall facts and figures; unfortunately, this is something educators and students invest a significant amount of resources developing

through tests and exams. Other educational strategies are required to help students develop their

higher-order thinking skills in various knowledge dimensions (Scheyvens et al., 2008, p. 51).

Reflection has been hailed as an approach for "deep learning" (Dummer, Cook, Parker, Barrett,

& Hull, 2008; Moon, 1999), developing critical thinking skills (Moon, 2006; Schön, 1987) and

encouraging metacognition (Moon, 2006). Therefore, although reflection in education is not a

new concept, how to assess reflection has remained challenging. Recent research on the

Reflective Learning Framework (RLF; Whalen & Paez, 2019) has aimed to address many of the

challenges associated with guiding, assessing, and evaluating student learning through

reflections. The objective of this research is to investigate how students perceive reflection,

specifically by using the Reflective Learning Framework, and whether they see the framework as

promoting cognition and metacognition, in addition to the higher-order thinking skills outlined

by Anderson et al. (2001) in the revised version of Bloom's Taxonomy of Educational

Objectives.

Background: Experience and Reflection

Experiential Learning

Experiential learning, including reflection, is not new to the field of geography or education. On

the contrary, Dummer, Cook, Parker, Barrett, & Hull (2008) state that "[f]ieldwork is, arguably,

the sine qua non of the geographer", and Healey (2005) demonstrates that active learning, such

as through fieldwork, is common in teaching and learning across the sub-disciplines of

geography. While not a new concept, there has been renewed focus on experiential learning in

formal education by various levels of government and post-secondary institutions (Whalen &

Paez, 2019). As educators, we understand the importance of experience as education, but many

of us who engage in such experiential educational strategies, such as fieldwork, also recognize

that they are not alone sufficient for deep and meaningful learning. Healey (2005 referencing

Johnston, 2003) clarifies that:

> [a]ctivity on its own, of course, does not bring about learning; it needs to be integrated with
> critical thinking…given the provisional nature of knowledge and the way that knowledge
> and the methods used to address questions within a discipline evolve, what we learn or teach
> is relatively unimportant; it is the basic approaches to learning, applied to the current
> questions facing a discipline, which are key.

Likewise, Scheyvens et al. (2008, citing Bonwell and Eison, 1991) note that "[a]ctive

learning requires more than simple activity… rather it should also encourage thinking and

reflection on learning activities."

Reflection

The Association for Experiential Education (undated) defines experiential education as: "a

philosophy … in which educators purposefully engage with learners in direct experience and

focused reflection in order to increase knowledge, develop skills, clarify values, and develop

people's capacity to contribute to their communities." Kolb and Kolb (2005) describe that

learners engage in a continuous cycle or spiral of experience, reflection, thinking, and acting.

Healey and Jenkins (2000) pioneered the use of reflective learning in geography education, and

highlighted the importance of an educator who guides the learner through each stage of the cycle

and helps them to make connections between each stage. Harrison, Short, & Roberts (2003)

conducted a survey of reflective learning in undergraduate geography, earth and environmental

sciences programs within the UK and found that it was still in its infancy, with many responses

indicating the belief that reflective learning is implicit in higher education and does not need to

be explicitly taught. However, reflection is now considered by many to be an important curricular component of the experiential learning process in geography and sustainability education (Brail, 2013; Kim, 2019; Rioux, 2019).

Again, the role of the educator is important. Just like other skills, deep and critical reflection is more effective when students are guided through the process (Moon, 1999), which can include providing learners with guidelines and rubrics (Dummer et al., 2008; Russell, 2005; Ryan, 2011, 2013). Harrison et al. (2003) highlight the value of educators moving beyond theories of experiential learning and reflection, noting that "[r]eflection will not occur by chance; educators need to devise exercises, techniques and tools to promote reflection." (p. 137). As seen throughout the literature, Dummer et al. (2008) discuss challenges associated with providing guidance for deep and critical reflection that supports creativity, flexibility, and offers clear direction on what is expected. In light of this renewed focus experiential learning, as well as the identified need to address climate change among other critical issues through action and sustainability education, questioning the ability of students to extract meaning from their experiential learning opportunities is relevant and urgent, and also empowering since it requires students to assume the role of storytellers (Burlingame, 2019).

Implementing Reflection in Sustainability Education: The Reflective Learning Framework

The first author has spent much of the past six years developing McMaster's Sustainable Future Program, which now sees approximately 650 students in five courses annually. The mission of the broader department is to "inspire in all students a desire for continued learning and inquiry through experiential education" (https://asp.mcmaster.ca/), and aims to accomplish this goal by

"providing students with opportunities for interdisciplinary, student-led, community-based, and experiential learning about sustainability" (https://asp.mcmaster.ca/). With respect to university sustainability education, the Sustainable Future Program would be classified by Molthan-Hill et al. (2019) as "Connecting (Transdisciplinary)", which the authors describe as being the "most innovative" way to integrate sustainability or "climate change education" into higher education curricula (pp. 1095-1096) .

Success with the program over the past five years bolsters confidence in our ability to provide students with robust academic content and opportunities for critical analysis, interdisciplinary discussion, and experiential learning. The crux of the matter is that while we can provide relevant content and the opportunity for learning through experience, we cannot guarantee that deep learning will happen purely as a result of participation in one or more of these courses (Scheyvens et al., 2008). As a result, and with a belief that reflection is critical to one's ability to learn through experience, the Reflective Learning Framework (hereafter referred to as RLF or Framework) has been adopted for guiding, assessing, and evaluating student learning through reflection on their experiences in this program. As expressed by Harrison et al. (2003), assessment of reflection remains problematic because "reflection on experiences and activities can be highly personal, incorporating emotions, opinions and beliefs" and that "[s]taff may feel uneasy marking such material." (p. 143) The RLF was developed with consideration to the inherent challenges of guiding, assessing, and evaluating student learning through reflection. Specifically, the Framework is aligned with the revised version of Bloom's Taxonomy of Educational Objectives (Anderson et al., 2001), and focuses on developing students' higher-order thinking skills. The Framework and associated resources, including a rubric and a guide, are the outcome of several years of design and testing in our sustainability courses. As of April

2019, the Framework, guide, and rubric have been used in more than 24 classes and with more than 2,100 students. For a full description of the development of the Framework and associated resources, see Whalen & Paez (2019).

The Reflective Learning Framework was developed attending to a patient and rigorous scholarly process. Its true value, however, can only be determined by the way students make use – and possibly benefit from it. To achieve insight into the students' perspectives, we approach this study as reflective practitioners, as recommended by Adriansen & Madsen (2014). As such, the objective of the research presented in this paper is to investigate the student perceptions of using the Reflective Learning Framework to guide, assess, and foster learning through experience.

Study Context

As of April 2019, the Sustainable Future Program at McMaster consists of four courses, one course in each of first, second, third, and fourth-year. Although students in all courses were included in the development of the RLF, the present paper is focused on students enrolled in the third-year course, *SUSTAIN 3S03 – Implementing Sustainable Change*, in the Fall of 2018.

SUSTAIN 3S03 runs annually and accepts students from all disciplines of study. In addition to lectures, tutorials, readings, and tests, the students also take part in a semester-long experiential learning project. For the project component of the course, students choose from a variety of previously identified sustainability challenges sourced from the Hamilton or McMaster community. Past examples include building a solar power generator for a local farmer, upcycling jute coffee sacks into marketable products for an independent coffee roaster, and identifying factors contributing to student food insecurity on campus in collaboration with the University's

student union and a national non-profit organization. The experiential learning project in 2018 made up 50% of the students' course grade. In addition to the project, and rather than an examination, students completed a written reflection of their learning, which was worth 20% of their course grade and was guided by and evaluated using the RLF. Students were provided with various forms of guidance and support in using the RLF and related resources, consisting of the following:

- **The RLF Guide for Students and Educators**. The Guide described David Kolb's Experiential Learning Theory and the role of reflection in the learning process, unpacked each of the eight RLF components and categories, included a sample evaluated reflection, and contained a rubric intended to support self- and peer-evaluation.

- **Tutorial provided by the course teaching assistant**. Approximately half-way through the semester, the teaching assistant (TA) presented information about the reflection assignment and the RLF, and provided the opportunity for the students to ask questions and discuss examples.

- **Additional guidance provided by members of the instructional team**. Students were encouraged to seek guidance from the course teaching assistants or the course instructor, as they felt comfortable.

- **Two-page handout of the RLF rubric**. Although the Guide always had a rubric included, it was traditionally near the end of the document and not visually attractive. In the Summer of 2018, the RLF rubric was visually enhanced and made available as a separate two-page document for easy reference.

- **Reflection workshop**. Another newly added resource was a 50-minute long reflective writing workshop, led by the first author separate from class and tutorial. There were two

back-to-back workshops offered approximately one week before the students' reflections

were due.

- **Optional pre-submission review by TAs**. TAs offered to conduct a cursory review of

    students' penultimate draft reflections, if submitted at least four days in advance of the

    final submission date.

With respect to word count, students had a flexible maximum of 2,000 words to complete

their reflection. The TAs used the same RLF resources and rubric provided to the students, and

they did not assess for spelling, grammar, or style, as long as the content could be clearly

understood. The reflection assignment was due three days following the last class.

Methods

Overview and Participation

For this study, a mixed methods approach to data collection was adopted, first conducting an

online survey, which included an option for participants to upload their course reflection, and

then conducting semi-structured interviews. The interviews were conducted by the first author.

While the quantitative data was valuable in obtaining a greater number and diversity of student

responses, the main focus here is on the rich qualitative data set obtained through interviews.

Following approval from the course instructor and from McMaster Research Ethics

Board (#1870), students who completed the course in December 2018 were invited to complete

an online survey in March 2019, and were then invited to participate in a follow-up interview.

Neither the survey nor the interviews were anonymous. Due to the small number of participants,

the questions asked in the survey, and the fact that the first author knew the students personally

through her involvement with the course, students would likely have been identifiable from their responses even without asking for their names. All participants consented to the conditions for the research, which includes reporting their data only in anonymous format.

Students received $5 through email bank transfer following completion of the survey and then were invited to take part in the interview. Interviews took place in March and April, 2019, and students received $20 cash upon arrival to the interview. All participants approved to have their interview recorded, which was later transcribed using Temi (https://www.temi.com/), an artificial intelligence transcription service. During the editing process, punctuation was added to facilitate the analysis process and readability of the text in a way that was true to how it was spoken. Thematic analysis took place over May and June of 2019.

The course included students from all of McMaster's six Faculties and the Arts & Science Program, which functions as its own Faculty. The interviews included students from all Faculties, except Social Sciences or Arts & Science.

Interviewing one's own students has a number of benefits as well as some challenges, as discussed by Adriansen & Madsen (2014). A key challenge is to avoid ethical conflicts. In this respect, it is important to note is that although the first author was involved with the course, she did not conduct any assessment or evaluation of students' work, and refrained from inviting students to participate in the study until after all of their course grades had been submitted to the Office of the Registrar. Furthermore, all students without exclusions were invited to participate in the study, therefore avoiding unethical signalling. The interviews took place in the first author's office, rather than a classroom, which was known by and easily accessible to the students.

Although students may have felt obligated to participate in the study or to endorse the Framework that the interviewer had developed, they were asked to offer open and honest feedback in order to support this research, and to further enhance the Framework and how it could best be used to support student learning. A reality of qualitative interviews is that there will always be a power relationship between the interviewer, who holds analytical control, and the interviewee, additionally so if the interviewer is a teacher and the interviewee is a student. With respect to positionality, since the interviewer was involved in the course from an administrative perspective, she was able to take advantage of insider information, such as knowledge of the content and context of the course. While also an outsider in that she experienced the situation different than the students, the interviewer was engaging in the study from her position as a graduate student and in quest of the expert knowledge from the student participants, which may have helped to level the power imbalance.

Interviews

Of the 33 students in the course, 16 students took part in a semi-structured, in-person interview. Interview questions asked about students' past experience with reflection in university courses, what they enjoyed and did not enjoy, how they approached reflection in SUSTAIN 3S03, which reflection resources were most or least valuable, their perceived value of reflection, and feedback for improving the RLF or how it is used in the course (see Interview Guide in Appendix A).

Thematic Analysis

The process for thematic analysis was modelled after Braun & Clarke (2006). An essentialist/realist epistemological approach was adopted to theorize experiences of the student research participants and the meaning of their perceptions based on what they said and the

language they used during their interviews. To keep with the inductive approach, during this stage of the process an effort was made to avoid consulting the literature to reduce the risk of any emergent themes being influenced during data analysis. Once the main themes and sub-themes were identified, the transcripts were uploaded into NVivo (https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/) to begin formal coding of the data into the themes or 'nodes'. Through continuous review, there was a process of familiarization with the data that made it easier to see past the text to better interpret the meaning underlying what the students were saying.

After this, the first author began to more formally write about the themes and how they fit together, which was helpful to develop a deep understanding and analysis of the data. Three main themes and their sub-themes were then identified, focusing on "internal homogeneity and external heterogeneity" (Patton 1990, as referenced by Braun & Clarke, 2006, p.91). This process proved challenging but extremely valuable to understand the data. For example, as is discussed in greater detail within the Results section, there are connections between cognition, metacognition, data retention, and data transfer; however, initially the authors lacked a deep theoretical understanding of those concepts necessary to articulate the connections between them. It was at this stage where the literature was consulted actively to help make sense of how the themes were connected. Once the literature was brought to bear in the interpretation of the themes, various connections between the themes seemed to naturally fall into place. It is important to note at this point that key themes were selected based jointly on the results of an inductive, data-driven approach to thematic analysis as well as what was most interesting and meaningful to a facilitator of experiential learning for upper-year university students. As Braun and Clark (2006) remind us, "researchers cannot free themselves of their theoretical and

epistemological commitments, and data are not coded in an epistemological vacuum." (p. 84).

Furthermore, they are clear that themes do not just "emerge" from the data, which would deny

"the active role the researcher always plays in identifying patterns/themes, selecting which are of

interest and reporting on them to the readers" (Taylor and Ussher, 2001 as referenced by Braun

& Clarke, 2006) and that if "themes 'reside' anywhere, they reside in our heads from our

thinking about our data and creating links as we understand them." (Ely et al., 1997: 205-6 as

referenced by Braun & Clarke, 2006). As such, identification and selection of themes made it

easier to identify related references within each data item. Ultimately, the process of

interviewing and studying interviews became in itself a reflective process supported by relevant

academic theory (Adriansen & Madsen, 2014).

The resulting set of themes is a rich representation of meanings across the whole data set.

For the purpose of this paper, one main theme and three sub-themes of interest were selected for

detailed discussion below, namely the acquisition of higher-level thinking skills (a full list of

themes and sub-themes is presented in Appendix B).

Results

The main theme identified from the data using the process of analysis described above was the

acquisition of higher-order thinking skills. This broad theme can be categorized into three sub-

themes, although this distinction is to some extent belied by the interconnections between them.

More specifically, these three sub-themes are: 1) development and use of cognitive skills; 2)

development and use of metacognitive skills; and 3) the value of reflection to support retention

and transfer of knowledge.

It is important to note that students did not describe their 'cognitive' or 'metacognitive'

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abilities in those terms, but rather they described ways of thinking that align with cognitive and metacognitive processes defined by Anderson et al. (2001). Furthermore, while students did describe their ability to 'transfer' knowledge, skills, and information, they more readily described how reflection helped them retain information with phases such as "it helps things stick" or "it helps me to remember". While it was possible to distinguish many of the cognitive and metacognitive processes that students describe using their own words, many of the processes overlapped, and sometimes students were vaguer in referencing, for example, their 'deep thinking'. Anderson et al. (2001) describes that although each cognitive process is individual, '[m]ost authentic academic tasks require the coordinated use of several cognitive processes as well as several types of knowledge" (p. 89), which is evident in the way students described their learning in this study and also how the three sub-themes are intricately interconnected. Each of the three sub-themes is discussed in more detail next (please note that participants in this research had the opportunity to review their quotes before the paper was submitted for publication, and there were no requests for withdrawal).

Reflection requires and develops cognitive skills

The cognitive dimension is defined as "[t]he way an individual thinks about or processes information in response to a particular setting, process, characteristic, attitude, or sensation." (Encyclopedia of Neuroscience, 2009. p. 782). Anderson et al. present six cognitive process categories in order from those that are "most commonly found in [learning] objectives…to those less frequently found" (p. 30), or as the categories are more commonly described, as ranging from the lowest to highest "level of complexity" (p. 34). In order from least to most complex, the cognitive process categories are: *remember*, *understand*, *apply*, *analyze*, *evaluate*, and *create* (Anderson et al., 2001).

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Students describe reflection as requiring and developing cognitive skills that can be associated with each of the six categories, but also more generally. Examples are found in each of the 16 interviews, with 74 references made in total.

Student #4 describes how the RLF requires use of specific cognitive process and how their cognitive skills are valuable to their learning beyond graduation:

"...when you're looking at what [the RLF is] asking you to do, like comparing concepts, inferring, differentiating, like that's always helpful. ...my favourite part of the reflections is when you compare it to theory. So you're like taking your experience and then being like, 'Oh look what you said at the beginning of this [course]'. It feels like everything I'm doing is useful instead of just, 'I do this course, I'm done; I do this course, I'm done; I do this reading, I'm done.' [K. Whalen: So you're able to draw connections between potentially disparate areas and bring them together and utilize the information with other applications?] Yeah, which I think is so helpful when you graduate, right? Because then your degree isn't just your degree, like you're processing things and you can connect things." ~ Student #4

Student #11 describes the value of their ability to critique, which involves making a judgement based on criteria and standards and is said to be "at the core of what has been called critical thinking." (Anderson et al., 2001. p. 84):

"Even just like understanding whether that first superficial reaction was valid in itself because sometimes the initial reaction was valid and you just build on it with the reflection. But I've found myself completely tearing down an idea that I thought I had or attached to myself because I reflected on the validity of the idea or decided, you know, what other perspectives or biases or underlying things kind of forced me to arrive at that conclusion. And just being able to kind of self-correct it and check myself because it is so easy to just allow your ego to guide your thought process and continue down one path. So just being able to be your own self check I think is more valuable than anything else." ~ Student #11

Student #7 describes how they like that the reflection framework allocates the majority of the marks towards students' demonstration of higher-order cognitive processes, rather than on their ability to recall their experience.

> *"There's almost no marks placed on the actual story, there's almost all the marks on the connections you're able to draw with the material, and I find that particularly useful because it's, on a personal note, shaped the way that I even think about my content now, and beyond even courses that require me to do reflection. When I'm doing a report, I'll actually start my process by storming via reflection. By setting out all of the different things, even if the topics and the headings are different, I'm still thinking about the same, you know, 'What are the important aspects of the story?' or even, 'How am I connecting this to my research?', 'How am I relating this to the course content or to the outcomes that I'm trying to achieve?' ...it's driving me to, rather than getting all of my research like I did in the first two years of my academic career and then using it to support my preconceptions, it's forcing me to consider what my conceptions are and forcing me to re-evaluate what I was actually thinking." ~ Student #7*

Reflection requires and develops metacognitive skills

Kuiper and Pesut suggest that "critical thinking is to cognitive skill acquisition as reflective thinking is to metacognitive skills acquisition" (2004. p.384), and there has been much consensus on the important role of metacognition in the learning process (Anderson et al., 2001; D. A. Kolb, 2015; Moon, 2006; Schraw, Crippen, & Hartley, 2006). James Zull describes metacognition such that "[i]n many ways, a learner's awareness and insight about development of his or her own mind is the ultimate and most powerful objective of education; not just thinking, but thinking about our own thinking…This comprehension may be our highest and most complex mental capability" (Zull, 2011). The subtypes of metacognitive knowledge include strategic knowledge; knowledge about cognitive tasks, including contextual and conditional knowledge; and self-knowledge (Anderson et al., 2001). Metacognition was referenced 175

times and by all 16 students interviewed. Student participants provided many examples of each type of metacognitive knowledge, as described below.

Strategic Knowledge

Student #12, Student #1, and Student #13 describe their strategic knowledge, which is "knowledge of the general strategies for learning, thinking, and problem solving" (Anderson et al., 2001. p.56). Anderson et al., referencing Weinstein and Mayer, 1986, describe how learning strategies can be grouped into three categories of "rehearsal, elaboration, and organizational" (p.56), and also describe general strategies for problem solving, such as the "[k]nowledge of means-end analysis as a heuristic for solving an ill-defined problem" (Anderson et al., 2001. p.57). Strategic knowledge was the most referenced form of metacognitive knowledge, referenced 67 times and by all 16 students interviewed.

Student #12, and many other students, kept a personal journal or notebook throughout the semester, and a few students described using a personal journal well before the course. Student #12 seems to describe writing in their notebook as a key organizational strategy for learning.

> *"…for me it was the notebook but maybe for other people it's not. But being able to draw in all of those important pieces makes it so easy to talk about after you've been thinking about it all along, instead of like, 'Okay let me quickly read through all these articles, and let me think about what I did.'" ~Student #12*

Similarly, a common theme is that reflection takes more time and deeper thought than what other academic assignments require. Student #1 describes learning how reflection requires them to invest longer periods of time dedicated to the process of recalling events and questioning their comprehension of their experience and the situation, which is related to the description

provided by Anderson et al. (2001) as "[k]nowledge of comprehension-monitoring strategy such as self-testing or self-questioning" (p. 57).

> *"So before I worked little by little, but after the reflection workshop it was more like long spans of just sitting there and like actually thinking about it and going through it and thinking, 'Okay, how did I feel at this point during the project and during our weekly meetings?' And like I went through our meeting minutes and was like, 'Okay, how did that affect me?'" ~ Student #1*

Student #13 describes that because they had taken the second-year course and knew that there would be a reflection assignment, they were more actively involved in the learning process throughout the semester, which is related to what Anderson et al. (2001) describe as "[k]nowledge of planning strategies such as setting goals for reading" (p.57).

> *"Just knowing that there was a reflection, I think I was much more aware of what I was doing, like much more active I would say. Rather than if it was just a random project I would just want to get it done and over with for the sake of the course, you know. I wouldn't really think about like, 'Why is this important to me?' and 'What impacts does it have?' you know? I don't think I would think about those." ~ Student #13*

Knowledge of Cognitive Tasks

Students also described their knowledge about cognitive tasks, including contextual and conditional knowledge, which includes "knowledge of different learning and thinking strategies… and what general strategies to use and how to use them", as well as knowing that some tasks are more difficult than others (Anderson et al., 2001. pp. 57-58). Knowledge of cognitive tasks was the least referenced form of metacognitive knowledge, but still referenced 31 times by 14 of 16 students interviewed.

Student #16 describes their knowledge that writing a personal reflection on their learning requires more thought and time than completing an opinion response to an article. Furthermore, they explain that reflection also requires them to externalize their thoughts through writing notes before starting to write their reflection:

"I don't think as much when I write an opinion response. I'm like, 'This is my opinion on it. This is why I think that. And that's about it.' The reflection, however, is a process. It's not something easy to write. I'm very used to doing things at the last minute and I learned in SUSTAIN that I can't just sit down and write a reflection. I really have to think through things, write my thoughts out and come back to them multiple times before I begin putting it all together. So there's a lot more thought involved." ~ Student #16

Student #14 compares their strategy for reflecting in their second year with how they approached it in their third year, and what they learned:

"And that's what I didn't do in SUSTAIN 3S03, I didn't give [myself] time for my reflection because I thought I could just open up a word document and just start writing. But that's not what I had to do. I needed to sit down and actually brainstorm all of the ideas and connect it. I thought that my paragraphs would be just formed in my word document as I started writing. But no, and that's not how it worked out in SUSTAIN 2S03. In SUSTAIN 2S03, I had to point form everything and brainstorm it all first before I started writing it in paragraphs." ~ Student #14

Self-Knowledge

Students describe their self-knowledge, which "includes knowledge of one's strengths and weaknesses in relation to cognition and learning" (Anderson et al., 2001. p.59), and mainly describe their motivational beliefs, a sub-set of self-knowledge, which includes self-efficacy beliefs, beliefs about goals, and beliefs about values and interests (Anderson et al., 2001). Self-knowledge was referenced 44 times and by 13 of 16 students interviewed.

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Student #12 describes their prior weakness in being able to draw connections between experience and education, noting that students in other disciplines may have been taught those skills. The student notes how, through reflection, they improved their ability to draw connections, which enhanced their appreciation for reflection.

"Maybe if I had the mindset of how reading the readings from class and going on the trip all kind of tied together in this reflection, which I think this is more like what Social Sciences students learn in their classes, versus what I did, which was never anything like this. It is all just math and physics and that stuff, I would have done it differently and appreciated the different aspects of the course more and how they tied into reflection. But I had looked at them as kind of separate. So, 'Go on the trip, okay did that, complete. Read the articles, okay, did that, complete'. I didn't think of it as one piece tying together. And then, if you look at my first reflection versus my last one, I don't really pull much academic theory into the first one. I just talk like it's – the word 'reflection' – I just talked about you know, 'I did this, I saw that, I did this, and blah blah blah'. But if you look at the last one, it's like 'well when I read about this, and then I did it in person, I understood what they meant by Nudge Theory', for example. So it was more, I think I was able to appreciate it more." ~ Student #12

Student #7 describes their motivation to have a deep understand of the information and knowledge they obtained in SUSTAIN 3S03 so that they could apply it in other contexts.

"I think the most important aspect of the reflection is saying 'How does it value or register on my scale? How am I actually going to use this?' When the professor has gone away and I am sitting there and somebody says, 'Okay, you have a degree now, what are you doing with it?' And seeing how I can take that information, having reflected on it, and move it into my own content and saying , 'This isn't this course's content', this isn't, 'I went to SUSTAIN 3S03, I'm carrying this bag of SUSTAIN 3S03 content'. No it's, 'I'm walking away with a new tool that I've put in my toolkit that I can now take and apply somewhere else', because I haven't just held it, I have taken it and said, 'This is now something that I'm going to use and this is how I'm going to use it.'" ~ Student #7

Student #7's statement above offers a good segue into the related sub-theme about

reflection supporting retention and transfer.

Reflection supports retention and transfer

As described by Anderson et al., "[t]wo of the most important educational goals are to promote retention and to promote transfer (which, when it occurs, indicates meaningful learning)" (2001. p. 63), but also state that "students often do not learn to transfer or apply the facts and ideas that they learn in the classroom to understanding their experiences in the everyday world" (. p.42). Of the six cognitive process categories identified in Bloom's Taxonomy, the *remember* category relates to retention while the other five (*understand*, *apply*, *analyze*, *evaluate*, and *create*) relate to transfer (Anderson et al., 2001. p. 66).

Important to our discussion about retention and transfer is the distinction between knowledge that is 'tacit' from that which is 'explicit'. Nonaka and Konno describe that while explicit knowledge can be easily communicated using words and numbers, tacit knowledge is difficult to communicate, personal, and rooted in experience, values, and emotions (1998). The authors describe two dimensions of tacit knowledge, with the first being the technical dimension often referred to as "know-how" and the second being the cognitive dimension, consisting of "beliefs, ideals, values, schemata, and mental models that which are deeply ingrained in us and which we often take for granted" (Nonaka & Konno, 1998. p.42). Important to this study on student perceptions of reflection, Nonaka and Konno state that "[w]hile difficult to articulate, this cognitive dimension of tacit knowledge shapes the way we perceive the world", that the interaction between tacit and explicit knowledge leads "to the creation of new knowledge" (1998. p .42). This strongly suggests that through externalization, tacit knowledge becomes explicit. Reflection, including introspection, is one method of making tacit knowledge explicit,

and therefore in creating new knowledge.

Student #2 describes the act of tacit knowledge becoming explicit by externalization through putting their knowledge into words:

"...just kind of learning what you got out of it and having to put it into words was good because...you have to actually think about it and have a solid answer for what you did and what you got out of it. Um, I don't know if I would say that it made me learn more, it just made me realize what I had already learned, if that makes sense." ~ Student #2

Student #11 describes their acquisition of tacit knowledge that can be transferred, but describes how, through reflection, knowledge and the transfer of it is made explicit, which adds value and enhances motivation to continue learning.

"Well I think that one of the goals of the course, aside from teaching the actual content is teaching the tools, the knowledge, and the skills that you need to be able to apply it outside. So like relating to other contexts, for example, is one of the biggest sections for me because I think I get the most use out of the reflection through understanding where else I can apply the ideas that I've learned. So having that emphasis on reflection forces you to sit down and take inventory of the things that you gained throughout the course. Because you don't really realize it as a learner. You're actively picking up things and you start applying them in the next course, but you never take the moment to pause and identify the fact that you did that. It's just pointing that out to yourself to make you understand that the learning experience is so valuable, and it kind of motivated me to continue searching out more learning experiences like that because I saw the value in front of me so obviously, because I took that inventory." ~ Student #11

Student #5 describes that when they reflect, their tacit knowledge becomes explicit and available for further introspection.

"I like reflecting because when I learn it and when I'm discussing things, it doesn't always stick, and I don't really know exactly what I'm trying to take away from it. And then when I

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sit down to reflect I'm, like, 'Oh, this person changed my opinion on this' and 'This is the overall takeaway in the end.'" ~ Student #5

Discussion

As described in the Introduction, the complexity of the sustainability challenges that lay ahead for current and future generations require higher-order thinking skills, self-knowledge, the ability to learn how to learn, and the ability to transfer knowledge to be effective in tackling such challenges. It has no doubt been part of the mission of institutions of higher education to teach students how to think and learn at higher levels. It has long been agreed that reflection is an important part of the experiential learning process and that it both requires and develops metacognition. This research on student perceptions of using the Reflective Learning Framework to guide, assess, and foster learning through experience provides evidence that students see reflection, at least in the way we have offered it, as both requiring and developing cognitive and metacognitive skills, as well as supporting knowledge retention and transfer.

It is important to note that this is the first time that the RLF has been used to support research on learning outcomes, in this case the acquisition of higher-level thinking skills. The richness of the dataset makes it impossible to discuss the whole gamut of themes identified in this paper; however, they suggest directions for future research. Of this, two considerations and areas for future research can be highlighted.

1) While student perceptions about their learning are important, their demonstrated cognitive and metacognitive abilities, as well as their ability to retain and transfer what they have learned would further enhance and complement these findings. Brail (2013) points to the potential for reflective journals to help students learn more deeply as well as to demonstrate their

higher-order thinking based on Bloom's Taxonomy. She also notes that "[t]here are very few studies that evaluate student learning based on assessment of students' reflective journals" (p. 243). Rioux (2019) conducted a similar study of her undergraduate students' perceptions of the influence of place-based environmental writing, including personal reflections, and found that while her assessment of their perceptions through interview and questionnaire showed that all of her students benefitted from the course, those findings were not consistent with her assessments of their written work. In stark contrast, only 50% of her students achieved the level of "authentic", which was third on the five-point scale she was using, between "superficial/subjective" at the lowest end and "agency/responsibility" at the highest. Similarly, in the study by Dummer et al. (2008), although many students responded positively about reflection, the authors note that "there was a tendency (especially amongst the weaker students) to be very descriptive in their write-up" and how additional guidance was required to encourage students to "link ideas, concepts and issues from their diary, rather than simply describing their experiences" and that "similar to an essay, the diary should connect the experiences and observations gathered in the field back to the literature, rather than treat the material as standalone" (p. 472). In presenting the inherent risks of the usual "post-hoc" methods of pedagogical research, such as follow-up surveys and interviews, in geography and other fields, Cotton, Stokes, & Cotton (2010), advocate for including observational methods, such as analysis of student diaries recorded while engaging in their experiences. The authors suggest observational method, or a mix of both, to offer deeper insight and a more robust understanding of the students' experience. As such, planned future research includes analyzing student reflections that were collected in the initial phase of this study to evaluate their demonstrated cognitive and metacognitive abilities, as well as their ability to tap into their affective domain.

Future studies could explore students' ability to retain and transfer information. However, because learning is iterative and learning through experience is a continuous cycle, the ability to retain what was previously learned for long periods of time, might just be an example of "nonlearning" (D. A. Kolb, 2015 p. 37).

2) While an integral part of geography education, fieldwork requires significant people and financial resources (Kent, Gilbertson, & Hunt, 1997). Additionally, Haigh (2001) demonstrates how using learning journals can be valuable tool for students and instructors, but concludes that that the sheer volume of content to analyze and assess remains a key challenge. Furthermore, many full-time and part-time faculty members are required to teach large classes with few, if any, teaching assistants to support them. The RLF was developed with the primary goal to support students in the Sustainable Future Program, which is sufficiently resourced to support students in their community-based and experiential learning. Significant consideration was also given to ensuring that others could also to adapt the RLF to fit their own needs. We recognize that using such a robust framework and offering various resources to support students in engaging with it are not feasible for many instructors. Future research could identify ways to adapt the RLF so that it requires fewer resources but still achieves the associated benefits to student learning.

Mochizuki & Bryan (2019) call for "a robust educational response which critically engages learners with the scientific, technical, behavioural, ethical, affective and practical dimensions of [climate change]" (pp. 12-13). Such an educational response, while also inspiring in students the desire and ability to go on learning, is no medial challenge. However, higher education has an important role to play in helping to address the complex sustainability

challenges that exist and lie ahead. Furthermore, supportive educational strategies and resources do exist and new ones are being developed or enhanced all the time. It is my hope that the RLF and associated findings from this research provide a platform for future research, application, and development.

Appendix A

Interview Guide

Do you consider yourself to be a reflective person? (How/not? Can you tell me more?)

I'm interested to know about your past experiences with reflection in university courses (please differentiate experiences from SUSTAIN courses and non-SUSTAIN courses)

In you past experiences with university reflections, was there anything that you particularly enjoyed or did not enjoy?

Can you tell me about how you approached reflection in SUSTAIN 3S03 by taking me through the timeline from when you recall thinking about the assignment, the process you went through in learning about and writing the reflection, including anything that stands out as meaningful?

Considering the various resources we provided (Guide, tutorial, TA, handout, workshop, extra help) which one(s) were most valuable and why? Which one(s) were least valuable and why?

Why do you think we place such a focus on reflection in SUSTAIN?

Do you feel that was the case in your experience?

Where do you see yourself in life, school, or career after graduation?

Do you see reflection being a valuable tool in any of these areas (if so, how. If not, why not?)?

What could we do, or not do, to make reflection in SUSTAIN better?

What could we do, or not do, to make the RLF or the way we used it better?

Is there anything else you would like to share with me at this time?

Appendix B

Full List of Coded Themes

Name	Sources	References	Description
Cognition, Metacognition, Retention, & Transfer	16	361	Reflection requires or enhances
- Metacognitive	16	175	Aggregate of "Meta-"
-- Meta - Strategic Knowledge	16	67	Examples or expressions of
-- Meta - Self Knowledge	13	44	Examples or expressions of
--- Meta - Self-Knowledge - Motivation	16	84	Examples or expressions of
-- Meta - Knowledge About Cognitive Tasks	14	31	Examples or expressions of
- Cognition	16	74	Examples or expressions of
- Retention	14	64	Examples or expressions of
-- Tacit Knowledge Explicit	13	44	Examples or expressions of
- Transfer	15	48	Examples or expressions of
Guidance and Support	16	244	Aggregate of section
- Guidelines - General	14	43	Any reference to guidelines, RLF or other
- Dialogue	15	39	Dialogue supports reflection
- Workshop	11	35	The workshop, or aspects of the workshop, were helpful
- RLF Guide & Handout	13	29	The RLF was helpful
-- Handout	11	16	Specifically the Handout was helpful
--Guide	10	13	Specifically the Guide was helpful
- Right or Wrong Track	10	27	Knowing if they were on the right or wrong track was helpful
- Example	7	14	Examples were helpful
- Optional Reflection in Tutorial	9	12	Optional reflections in tutorial were helpful
- Prompts	6	11	Prompts were helpful, in Syllabus, Workshop, or using the Guide and/or Handout
- Reflect Along the Way	6	10	Reflecting along the way, independently or as part of course assignments, was helpful
- Early Submission	6	8	The opportunity for early submission was helpful
Stress	16	134	Aggregate of section, including stress, being overwhelmed, confused, challenged, and sometimes negative aspects
- What to Write & How to Articulate	14	26	Includes what to write about, gaining clarity of thought, how to express or articulate, and general writing process
- Grades or Marks	11	23	Includes marks for RLF criteria or the overall assignment
- Other	12	16	Items that did not fit into an identified category and could not make up their own
- Stress or a Positive Challenge	6	15	Includes explicit or implied descriptions of stress as well as enjoyment or positive challenge
- Word Limit	9	13	Includes word limit too high, to low, or expectations of either that caused a level of stress
- Structure	7	11	Specifically related to not knowing if the reflection should be in 8 paragraphs as presented in the RLF
- On the Right Track	6	11	Not knowing if they are on the right track or not
- Guidelines	7	10	RLF or assignment guidelines
- Prior or Lack of Experience with Reflection	5	9	Includes having prior experiences or lack of experience that shape perceptions of reflection
Exposure & Practice Helps	14	50	Exposure to both the RLF and reflection in general is helpful
My Discipline	16	48	Experiences, ways of thinking or learning, that are specific to the student's faculty or program
Takes Time	12	40	Reflection takes time, as well as related references to pausing, sitting down, stop and think
Flexible vs. Rigid	15	39	General comments about the RLF, or other frameworks in comparison, being flexible or ridged
Individual Thought	15	39	Reflection requires or enhances individual thought. Overlaps in some cases with Metacognition
Enjoyment	12	35	Enjoyment of, value found in, positive benefits of reflection
- Favourite Part of the RLF	8	13	Reference to their favourite, most valuable, most beneficial part of the RLF
Meaningful Experience	11	24	It is easier or more valuable to reflect on a meaningful experience, often compared to a less meaningful experience
Internal vs. External	11	23	Differentiating between reflecting internally vs externally, or vice versa
Forces	10	20	References made to being 'made to' or 'forced to', usually framed positively
Value Diversity of Thought	7	14	Reflection helps to value diversity of thought, mainly related to valuing perspectives of those from different disciplines
Value the Experience More	8	14	Reflection helps to value the experience more, but finding and extracting value from the experience

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Introduction to Chapter 4

Reflection: I couldn't have been happier with the results of my study on student perceptions. I felt like beaming, "they liked it, they really liked it!" And through the high of presenting those results was a nagging feeling that I knew they would like it, because other educators have presented similar findings about how their students generally enjoy reflecting. However, in many of those same studies, the authors report that their students' perception of their learning through reflection was not actually demonstrated in their reflective writing. Again, I was optimistic because I had read some incredible reflections from students in our courses – most of which actually surprised me with the level of introspection, insight, and critical thinking. Still, the questions remained – was my unconscious bias for my own framework and my own students clouding my vision? Were the reflections created by students using the RLF significantly different from reflections from students who had used another framework?

Chapter 4: Reliability of the RLF and Students' Demonstrated Higher-order Thinking Skills as Inferred from Reflections in Geography and Sustainability Courses

Abstract

Experiential education partnered with guided reflection is thought to support students with higher-order thinking skills. In this study, 44 reflections from two university-level sustainability courses were compared. In both courses students were asked to write a reflection, but only one course used the Reflective Learning Framework (RLF). Tests of interrater reliability support the consistency of the RLF when used by trained raters. Furthermore, comparison of means using t-tests shows significant differences between mean ratings for the two courses. This provides evidence of the effectiveness of the RLF for students to apply and demonstrate the use of higher-order thinking skills.

Introduction

The United Nations has called on universities to play a leadership role in achieving the Sustainable Development Goals, noting that the issues underlying the Goals are so complex that "lasting solutions will only be achieved through multidisciplinary, cross-sectorial, collaborative approaches, which require new ways of thinking, new talent, and new ideas" (United Nations, 2019). To be effective in tackling such complex challenges, it is urgent that current and future generations are properly equipped with higher-order thinking skills. Although it has been

embedded into the mission of universities to teach students how to think and learn at higher levels, Benjamin Roger (2008) notes that "[u]nder our present organizational model, faculty have no way of knowing whether their courses…in fact develop these greatly valued skills in their students." (p. 53). More specifically related to Education for Sustainable Development, Straková and Cimermanová (2018) conclude that "it should not be taken for granted that teachers know how to develop the competencies that are necessary for sustainable development" (p. 1) – including critical thinking. Anderson et al. (2001) point out that the higher-order cognitive process categories included in Bloom's Taxonomy, which include the categories of *analyze*, *evaluate*, and *create*, are less often found in academic learning objectives. The authors do not explain why higher-order thinking skills are found less often in learning objectives, but it might be that they are perceived as requiring too much work from students and instructors (Scheyvens, Griffin, Jocoy, Liu, & Bradford, 2008), or perhaps because they do not lend themselves easily to assessment and evaluation in an outcomes-driven system (Whalen & Paez, 2019).

Recent research on the Reflective Learning Framework (RLF; Whalen & Paez, 2019) has aimed to address many of the challenges associated with guiding, assessing, and evaluating students' higher-order learning through reflections, as well as to investigate how students perceive reflection (Whalen & Paez, in press). Student perceptions about their learning are valuable due to the positive relationship between outcomes in the affective domain and success in the cognitive domain (Boyle et al., 2007). However, while students' feelings about their learning through reflection are important, so are their demonstrated cognitive abilities, since these are important to our understanding of the role of reflection in students' higher-order learning gained through experience. The purpose of this research is to investigate students' demonstrated higher-order thinking skills observed through their reflections on their experience,

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specifically by using the Reflective Learning Framework and assessment of higher-order

cognitive skills outlined by Anderson et al. (2001) in the revised version of Bloom's Taxonomy

of Educational Objectives (see Figure 3 for a depiction of how the Framework and Taxonomy

are aligned).
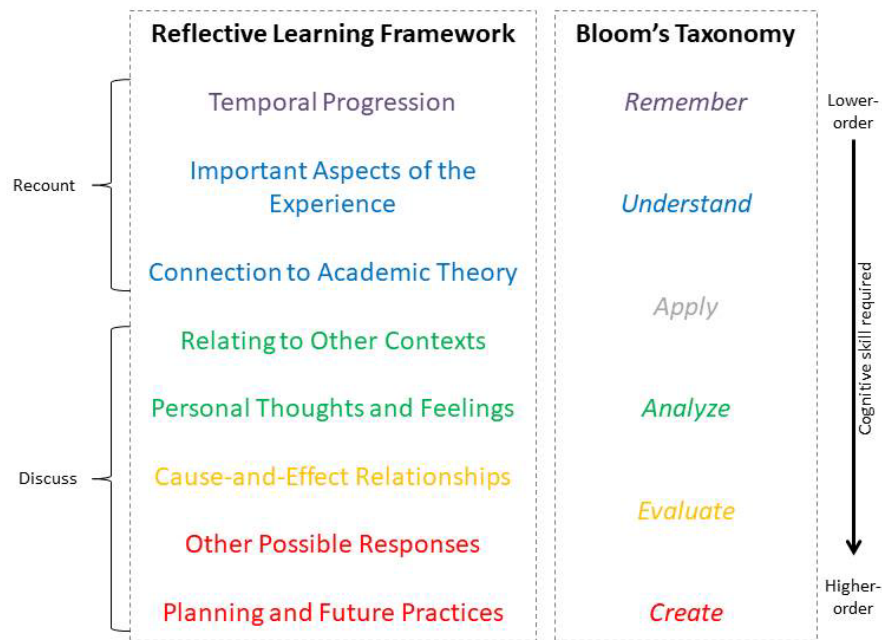
Figure 3. Author's depiction of the two RLF sections and eight categories, and their general alignment with the cognitive process categories from Bloom's Taxonomy

More concretely, this paper has two objectives. First, it is important to verify whether the

RLF can provide consistent assessment of cognitive skills. Previous research of student

perceptions of reflection provides evidence of the RLF's efficacy to both require and develop

students' cognitive and metacognitive skills, as well as support retention and transfer of

knowledge (Whalen & Paez, in press). However, the RLF has not been tested for interrater

reliability. In other words, while students' feelings about the framework tend to be positive, there

is yet no evidence that it can be reliably used for consistent assessment. Secondly, contingent on

RLF's consistency, we are interested in whether and to what extent its use can help students develop, apply, and demonstrate the use of higher-order cognitive skills.

To achieve these two objectives, we obtained a total of 44 written reflections from two university-level courses. Of these, 24 reflections were from a third-year sustainability course and the other 20 were from a second-year environmental issues course. Although the reflections were similar in nature, a key difference between the two courses is that the reflections from the second-year environmental issues course predate the development of the RLF. The third-year sustainability course, in contrast, used the RLF for teaching and evaluation. The two sets of reflections were given to trained evaluators for assessment without disclosing their provenance. Accordingly, the evaluators assessed them without knowledge of the difference in student training between the two courses.

Tests of interrater reliability were conducted and, although there was variability at the granular level of evaluation, overall estimates suggest good agreement among raters. Comparison of mean ratings was performed using t-tests, and overall comparisons demonstrate that the differences in mean values are significant. While the sustainability students were evaluated significantly higher, in both the Recount (more lower-order cognitive skills) and the Discussion (more higher-order cognitive skills) categories of the RLF, of greatest interest to the authors of this study are the RLF categories that differ most between the two groups of reflections.

The results of this study reveal that students succeeded to a greater extent in terms of demonstrating higher-order cognitive skills when they were trained for their reflections using the RLF. The findings presented here contribute to the literature in support of various forms of

guided reflection (Dummer, Cook, Parker, Barrett, & Hull, 2008; Moon, 1999; Russell, 2005; Ryan, 2011, 2013), rather than the belief that knowing how to reflect is implicit and does not need to be taught (Harrison, Short, & Roberts, 2003), while also providing support for the use of the RLF as a robust framework that can be used to guide, assess, and evaluate written reflections in a university course.

Background: Experience and Reflection

Experiential Learning

Experiential learning has long been part of geography education (Dummer et al., 2008; Healey, 2005), and received renewed attention across disciplines by various levels of government and post-secondary institutions who are increasingly interested in experiential education (Whalen & Paez, 2019). While experience is an important part of education, the activity alone is insufficient for deep and meaningful learning. For deep learning to occur, the experience must also include critical thinking (Healey, 2005 referencing Johnston, 2003) and reflection (Scheyvens et al., 2008). Healey (2005 referencing Johnston, 2003) argues that,

> [a]ctivity on its own, of course, does not bring about learning; it needs to be integrated with critical thinking…given the provisional nature of knowledge and the way that knowledge and the methods used to address questions within a discipline evolve, what we learn or teach is relatively unimportant; it is the basic approaches to learning, applied to the current questions facing a discipline, which are key. (p. 191)

Similarly, Scheyvens et al. (2008 citing Bonwell and Eison, 1991) state that "[a]ctive learning requires more than simple activity…rather it should also encourage thinking and reflection on learning activities." (p. 51). As such, reflection is an integral component of experiential learning, and should be purposefully incorporated into experiential educational strategies.

Reflection

The Association for Experiential Education (undated) defines experiential education as: "a philosophy … in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, clarify values, and develop people's capacity to contribute to their communities." Kolb and Kolb (2005) describe experiential learning as a continuous cycle or spiral of experience, reflection, thinking, and acting. Reflective learning is considered to be an important part of the experiential learning process in geography and sustainability education (Brail, 2013; Healey & Jenkins, 2000; Kim, 2019; Rioux, 2019). Despite the interest, it is not widely understood why or how reflection should be guided or assessed as part of students' coursework (Harrison et al., 2003). Although the literature on reflection in learning is robust, much of the research has been based on student perceptions alone. Indeed, in her evaluation of student learning through reflection on their service learning experiences, Brail (2013) points out that, "[t]here are very few studies that evaluate student learning based on assessment of students' reflective journals" (p. 243). Interestingly, when observational studies have been conducted, they present a disconnect that is problematic. In the study by Dummer et al. (2008), while many students responded favourably to their reflection assignments, the authors recognized that "there was a tendency (especially amongst the weaker students) to be very descriptive in their write-up" and concluded that additional guidance was necessary to help students to "link ideas, concepts and issues from their diary, rather than simply describing their experiences" and that "similar to an essay, the diary should connect the experiences and observations gathered in the field back to the literature, rather than treat the material as standalone" (p. 472). Similarly, Rioux (2019) studied her undergraduate students' perceptions of her place-based environmental writing course and found

that all of her students felt that they benefitted from the course. However, her students' feelings were not consistent with her assessments of their written work in that only half of them achieved the level of "authentic", which was third on the five-point scale she was using, between "superficial/subjective" at the lowest end and "agency/responsibility" at the highest. Cotton, Stokes, & Cotton (2010), recommend avoiding the "post-hoc" methods of pedagogical research, such as follow-up surveys and interviews in favour of observational methods, such as analysis of actual student reflections, to offer deeper insight and a more robust understanding of the students' experience.

A challenge for the studies cited above is the lack of systematic ways of assessing the skills needed for meaningful reflection. This is a gap that the RLF (Whalen & Paez, 2019) has tried to bridge. Accordingly, for this study, we are interested in implementing a direct observational approach (Cotton et al., 2010) of student reflections, to compare students' achievement of the "authenticity" sought by Rioux (2019) – which for our purposes is the ability to demonstrate higher-order cognitive skills in reflection writing.

The Reflective Learning Framework

As the first author was developing McMaster University's Sustainable Future Program and over-arching Academic Sustainability Programs Office, which aims to "inspire in all students a desire for continued learning and inquiry through experiential learning" by "providing students with opportunities for interdisciplinary, student-led, community-based, and experiential learning about sustainability" (https://asp.mcmaster.ca/), the main challenge was in how to guide and assess students' deep learning obtained through their experience. The Reflective Learning Framework was developed to guide, assess, and evaluate students' learning in the program.

Specifically, the Framework was designed to align with the revised version of Bloom's Taxonomy of Educational Objectives (Anderson et al., 2001), and focuses on developing students' higher-order thinking skills. The Framework and associated resources, including a rubric and a guide, are the outcome of several years of design and testing in our sustainability courses. As of December 2019, the Framework, guide, and rubric have been used in more than 29 classes and with more than 2,500 students. For a full description of the development of the Framework and associated resources, see Whalen & Paez (2019).

The Reflective Learning Framework was developed by employing the rigorous and scholarly process of grounded theory methodology. Recent investigations have focused on student perceptions of engaging with and using the Framework (Whalen & Paez, in press). As such, and in attending to the stated gaps in the literature regarding the demonstrated benefits of reflection in developing students' higher-order thinking skills, the objective of the research presented in this paper is to investigate university students' higher-order thinking skills as observed through their written reflections on their experiences in the Sustainable Future Program.

Study Context

As described above, there were two courses for which reflections were obtained and used for analysis. Both courses and their reflection assignments are described in this section.

Second-year Environmental Issues Course

To provide a baseline for comparison, the first author obtained a set of 350 de-identified reflections from a second-year course on environmental issues. The course was taught at the

same institution, in the Faculty of Science, and in the Winter semester of 2012, and therefore

predates the development of the RLF. Students enrolled in the course took part in a personal

lifestyle challenge, which was based on The Lifestyle Project of Kirk and Thomas (2003).

Through the project, students learned about their environmental impact by engaging in a

three-week, self-directed, lifestyle challenge. Students chose three categories from a list of six in

total, which included the categories of heat, electricity and water, and eat efficiently. Students

kept a journal of their experiences and submitted three formal reflections for evaluation. The

reflections were each worth 5% of their overall course grade. In addition to a tutorial provided by

the course instructor, guidance given to the students included a rubric, which is represented in

Table 4 (Kirk & Thomas, 2003) and outlined the requirements to achieve a mark of 0, 1, 2, or 3

in four areas. Additionally, the first and third reflection included a homework question.

Table 4. The Lifestyle Project assessment rubric

Lifestyle Project Journal Assessment Rubric

3 marks	2 marks	1 mark	0 marks
Completed all 3 categories for the required number of days this week	Completed most of the categories for the required number of days this week	Completed some of the categories for some of the days	Missing entire categories or days
Documented significant efforts of conservation in every category, and in some cases went beyond the basic requirements of the category	Conservation efforts met the basic requirements within each category	Conservation efforts met the requirements in some categories, but not all	Conservation efforts were minimal
Journal is descriptive and specific, giving details and or calculations about each action completed	Summarized actions undertaken in each category, but not in great detail	Gave general descriptions of actions taken	Very brief mention of actions taken
Journal is reflective and provides thoughts about the effects and impacts of the project	Journal contains some reflection on the effects or impacts of the project, but not in-depth	Journal contains occasional reflection of certain effects or impacts of the project	No reflection on the effects or impacts of the project
Applies only to additional calculations or embedded homework questions that may be assigned for a given week.			
Additional homework questions or calculations are complete and correct	Additional homework questions or calculations are mostly correct, but missing some detail, or contain minor mistakes or misunderstandings	Additional homework questions or calculations contain significant mistakes or misunderstandings	Did not include calculations or homework questions

Overall score for this week _____

The two prompting homework questions for the third and final reflection, which is the

reflection assignment we used for this study, were: "Do you plan to continue with any of the changes made during the lifestyle project? Why and how?" and "Are there changes you made that you don't plan to continue past this week? Why?" Students had a limit of two pages per reflection and were encouraged to include photos. Each of the three reflections had specific due dates within the semester and before exams started.

It is our view that this reflection is already an attempt at a systematic process for training and assessment. While it is likely more robust, it is probably typical of the way reflection is implemented in a majority of courses having a reflection assignment. To offer examples from the literature, Clements & Cord (2011) describe their process of having students keep 'e-logs' while on career placement, which is followed by the students drawing on course content, their e-logs, and their previous experience, to reflect on their placement and answer a series of questions. The authors describe the questions that students were asked to reflect on, such that they were to:

> "provide an overview of the organisation and their key roles, outline the skills applied on internship that were developed at university, identify the skills developed during placement including the development of graduate qualities and personal strengths, reflecting on their learning style and their overall experience" (Clements & Cord, 2011 p. 122).

With respect to assessment, students receive a grade of 'satisfied' or 'unsatisfied' (Clements & Cord, 2011); however, if a rubric was used to determine the grade, it was neither discussed nor presented. Placing similar value on the act of students logging experiences as they occur, Qualters (2010) also highlights the importance of capturing the learning process in that, "to gather valuable data about learning during an experience, we must understand the process of the learning" (p. 58). Qualters describes the I-E-O (Input – Environment – Output) model of evaluating students before the experience, during the experience, and after the experience (2010).

The author provides an example of the model from a course whereby students went into the community to provide health education to homeless people. Students were surveyed about assumptions, conceptions, and skills before going into the field and they kept structured reflections during their experience. Following their experience, students were surveyed again and asked specifically about their change in attitudes, new insights about working with the homeless population, and about future career in community health education (Qualters, 2010). With respect to assessment, Qualters describes that the survey is, "not meant to test student knowledge but to provide a study guide that discloses the organization, content, and level of thinking expected in the experience" (Qualters, 2010 p. 60). These examples are meant to offer insight about how a typical model is adapted and implemented in different course disciplines, with the commonalities being that the students capture their experiences through ongoing reflection and then create a formal reflection focused around discipline-specific questions. It is important to also consider the relative lack of focus on formal assessment on defined criteria in the two examples. Qualters (2010, sourcing Elman 1993) offers some insight by providing 'four essential questions' for faculty as follows: why are we doing assessment, what are we assessing, how do we want to assess in the broadest terms, and how will the results be used? Given these questions, it is evident that perhaps not all faculty have considered these questions and it is a reminder that not all faculty have the same goals or purpose for assessment.

SUSTAIN 3S03 – Implementing Sustainable Change

The RLF was developed within McMaster's Academic Sustainability Programs Office, which consists of a number of programs, including the Sustainable Future Program. As of April 2019, there were four SUSTAIN courses, all at the undergraduate level. Although students in all courses were included in the development of the RLF (see Whalen & Paez, 2019), the present

paper is focused on students enrolled in the third-year course, *SUSTAIN 3S03 – Implementing Sustainable Change*, in the Fall of 2018, which used the most up-to-date version of the Framework.

All courses in the program maintain a focus on interdisciplinary, student-led, community-based, and experiential learning about sustainability. Furthermore, all SUSTAIN courses require students to produce one or more written reflections on their experiences, using the RLF. As such, students in SUSTAIN 3S03 come from all disciplines of study and, in addition to lectures, tutorials, readings, and tests, students also take part in a semester-long experiential learning project. For the project component of the course, students choose from a variety of previously-identified sustainability challenges sourced from the Hamilton or McMaster community. Past examples include: developing a program for IT collection, reuse, and recycling; designing a mobile greenhouse for a local urban farmer; and implementing an apiary on campus. The experiential learning project in 2018 made up 50% of the students' course grade. Rather than an examination, students completed a written reflection of their learning, which was worth 20% of their course grade and was guided by and evaluated using the RLF. In contrast to the environmental issues class, which received prompting questions to respond to, the sustainability students were required to create their own reflection theme and given little direct guidance in the form of questions. Sustainability students were provided with various forms of guidance and support in using the RLF and related resources, consisting of the following:

- **The RLF Guide**. The Guide, which is intended to support students and educators, described the role of reflection in the learning process, unpacked each of the eight RLF

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components and categories, included a sample evaluated reflection, and contained a
rubric intended to support self- and peer-evaluation.[2]

- **Tutorial on reflection**. Approximately half-way through the semester, the teaching
  assistant (TA) presented information about the reflection assignment and the RLF in
  tutorial.

- **Additional guidance**. Students were encouraged to seek guidance from the course
  teaching assistants or the course instructor.

- **RLF rubric**. Although also found in the Guide, the rubric was made available as a
  separate two-page document for easy reference.[2]

- **Reflection workshops**. Two optional 50-minute long reflective writing workshops, led
  by the first author and separate from class and tutorial were offered. The workshops took
  place approximately one week before the students' reflections were due, and all students
  who attended received a hard copy of the two-page RLF rubric.[2]

- **Pre-submission review by TAs**. TAs offered to conduct a cursory review of students'
  penultimate draft reflections, if submitted at least four days in advance of the final
  submission date.

The students had a flexible 2,000-word limit on their reflection. To support their
evaluation, the TAs used the same RLF resources and rubric provided to the students. The
reflection assignment was due during the examination period, three days following the last class.

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[2] Up-to-date versions of all RLF resources can be found online at https://asp.mcmaster.ca/resources

Materials

Following approval from the course instructor and from McMaster Research Ethics Board
(#1870), students who completed the sustainability course in December 2018 were invited to
complete an online survey in March 2019, and were then invited to participate in a follow-up
interview. Neither the survey nor the interviews were anonymous. Due to the small number of
participants, the questions asked in the survey, and the fact that the first author knew the students
personally through her involvement with the course, students would likely have been identifiable
from their responses even without asking for their names. All participants consented to the
conditions for the research, which includes reporting their data only in anonymous format. As
part of the survey, students were asked to upload a copy of their course reflection as well as for
permission to use their reflection for research purposes. Students were given the opportunity to
review and revise any aspect of their reflection that they liked, before sharing it for use in
research. They were given the prompt, "[f]or example, if you want to change the names of any
individuals you mention, or reframe any thoughts or feelings you had which may make you feel
uncomfortable now, please do feel free to do so". Of the 33 students enrolled in the course, 25
took the survey, and 24 made their reflections available for further study. As captured in the
survey response, 19 of the 24 student authors had used the RLF previously in another SUSTAIN
course. Furthermore, 9 students expressed having "lots of experience with reflection" (more than
three courses, or equivalent), 13 had "some experience with reflection" (between one and three
courses, or equivalent), and only one student stated having "no experience with reflection" in
university.

Again, the goal of this study is to investigate university students' higher-order thinking skills as observed through their written reflections on their experiences in the Sustainable Future Program, and specifically through our analysis we wanted to determine if students who used the RLF demonstrated more higher-order cognitive skills than would students who were given general guidance. Our hypothesis was that students would demonstrate more higher-order cognitive skills if and when they were provided guidance to do so.

In the Winter of 2019, approximately one year following the completion of the 2018 SUSTAIN 3S03 course, the two TAs who had been responsible for each evaluating approximately half of the 33 SUSTAIN 3S03 course reflections were hired by the first author to both re-evaluate a sample of the SUSTAIN reflections as well as a sample of the 2012 environmental issues course reflections. The two evaluators, who had since graduated, were not aware of the purpose of the study. They were simply asked for their support in re-evaluating 44 reflections using the RLF. The first author provided the following instructions and notes of guidance to the evaluators, before they began evaluating the reflections:

Instructions

(1) Re-read pages 8-17 and 19-22 in RLF Guide, as a refresher on the criteria.

(2) Have the RLF Handout on hand when evaluating the reflections.

(3) Consistently evaluate each reflection, alternating back and forth between the two groups of reflections.

(4) Enter each evaluation in the excel sheet provided, as labelled.[3]

Notes of guidance

- None of the student authors will ever receive their assessments, evaluations, or comments. So, if you believe that someone deserves a failing grade, you don't have to worry about how they might feel about it.

- Comments are appreciated, but not necessary. I am mainly concerned that you focus on consistency and process.

- If you do make comments, feel free to add them into the first open column in the Excel sheet, or directly onto the reflection, using the comments tool. If you make your comments directly on the reflection, please just let me know that there are "comments within reflection" on the Excel sheet, so that I know to go in and look for them.

- Please don't consult on grades with each other. It is my hope that we will each do an independent evaluation of the reflections to get the 'true' and natural response based on the training we have received thus far. (Whalen, 2019)

Both evaluators and the first author evaluated each of the 44 reflections on all 21 RLF criteria, which provided the basis for our analysis of both interrater reliability and to compare differences in reflections between our two samples.

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[3] The Excel template included a row for each unique ID, pre-labeled for each of the 44 reflections, and 21 columns, pre-labeled for each RLF criteria.

Analysis and Results

The analysis consisted of tests of interrater reliability and independent samples t-tests to compare the mean values of the assessments.

Note: The ethics protocol that governs this study prevents us from sharing the students' reflections. On the other hand, the evaluations and the code used in the analysis are available for download at the following site: https://github.com/paezha/Reflective-Learning-Framework-Comparison-of-Mean-Scores

Interrater Reliability

A test of interrater reliability (IRR) was performed to quantify the degree of agreement between independent evaluators, following guidance by Hallgren (2012) and by Koo & Li (2016).

The experimental setup was a fully crossed design, meaning that all 44 subjects were rated by the same three coders. Furthermore, since the RLF criteria are ordinal variables, we employed intra-class correlation (ICC), which is "one of the most commonly-used statistics for assessing IRR for ordinal, interval, and ratio variables…suitable for studies with two or more coders… [and] for fully cross designs" (Hallgren, 2012 p.9).

As described by Hallgren, "…all ICC variants share the same underlying assumptions that ratings from multiple coders for a set of subjects are composed of a true score component and measurement error component" (2012 p.9).

The equation is such that,

$$X_{ij} = \mu + r_i + e_{ij},$$

"where X_{ij} is the rating provided to subject i by coder j. μ is the mean of the true score for variable X, r_i is the deviation of the true score from the mean for subject i, and e_{ij} is the measurement error" (Hallgren, 2012 p.9) Specifically, we used a 'two-way random-effects' model because we selected our raters from a larger population of raters with similar characteristics (Koo & Li, 2016), which included being trained members of the course educational team. When deciding between using a 'single rater' or 'mean of k raters' type, we chose to use the mean of all three raters because we were more interested in the comparison between the two sets of reflections and because we did not believe that the measurement of one single rater should be the basis for the actual measurement. Furthermore, training judges to the point of exact agreement is highly resource intensive (Steven, 2004), and one of the objectives of this study was to re-create conditions that were as similar as possible to that of a typical course experience. One might wonder why we didn't designate the first author as the single rater, given their familiarity and expertise with the framework. While we recognized the potential value of their expertise, we were interested in the ability of reasonably trained raters to come to the same conclusions. The results show the consistency between the raters as discussed. Finally, we chose to define 'absolute agreement' over 'consistency' to determine how closely raters agreed on the score given to each student on each RLF reflection component. As such, ICC estimates and their 95% confident intervals were calculated using R Studio version 3.6.3 based on a mean-rating (k = 3), absolute-agreement, 2-way random-effects model. Based on the 95% confident interval, ICC values less than 0.5 indicate poor reliability, between 0.5 and 0.75 indicate moderate

reliability, between 0.75 and 0.9 indicate good reliability, and greater than 0.90 indicate excellent reliability. (Koo & Li, 2016).

In general terms, we found that ICC estimates were lower for the individual RLF criteria due to the inherent difficulty to achieve agreement at the most granular levels of the rubric. The analysis at the level of categories, on the other hand, leads to much higher ICC estimates. Analysis is based on the sections of "Recount", "Discussion", and "Total", which is based on the total score for a reflection (see Table 5).

The results with respect to the Recount section provide an ICC estimate of 81.2, and a confidence interval between 69.2 and 89.1. We obtained an ICC estimate of 80.3, for Discussion, with a confidence interval between 67.6 and 88.6. Finally, using the total score of each reflection, we obtained an ICC estimate of 86.6, with a confidence interval of between 78.0 and 92.3. As such, at these aggregate levels, we can assume that the level of agreement is moderate to good. However, as can be expected, there was greater variability at the more granular levels whereby some specific RLF categories had moderate to good agreement and others had poor agreement. The full results are presented in Table 5.

As such, this measure also supports the reliability of the RLF to be used when multiple evaluators are grading students' work, such as in a large course with multiple teaching assistants.

Table 5. Results of IRR estimates

RLF Category	ICC Estimate	Confidence Interval	RLF Section	ICC Estimate	Confidence Interval	RLF Total	ICC Estimate	Confidence Interval
Temporal Progression	0.556	0.275 < ICC < 0.741	Recount	0.812	0.692 < ICC < 0.891	RLF Total	0.866	0.78 < ICC < 0.923
Important Aspects of the Experience	0.0573	-0.517 < ICC < 0.445						
Connection to Academic Theory	0.894	0.824 < ICC < 0.939						
Relating to Other Contexts	0.773	0.594 < ICC < 0.875	Discussion	0.803	0.676 < ICC < 0.886			
Personal Thoughts and Feelings	0.212	-0.201 < ICC < 0.517						
Cause and Effect Relationships	0.18	-0.219 < ICC < 0.488						
Other Possible Responses	0.19	-0.23 < ICC < 0.502						
Planning and Future Practices	0.482	0.136 < ICC < 0.701						

Independent Samples t-test

In comparing the two data sets, we analyzed the mean ratings of each of the 21 RLF criteria, which map to the cognitive processes outlined by Anderson et al. in Bloom's Taxonomy (Anderson et al., 2001). To compare the mean ratings of each of the 21 RLF criteria between the two data sets, we ran a two sample, one-tailed, t-test in R using a 95% confidence interval, assuming non-equal variances, and signalling that the variables were independent. Rejecting the null hypothesis of equal mean values at p-values less than 0.05, the results show that the 24 sustainability reflections (M = 34.49, SD = 3.03), compared to the 20 environmental issues reflections (M = 26.26, SD = 3.06), achieved significantly higher ratings overall, t(37.7) = 8.12, p = p < 0.001, allowing us to reject our null hypothesis that the mean scores on the reflections are equal. When looking at the Recount sections only, the sustainability reflections (M = 8.22, SD = 1.01), compared to the environmental issues reflections (M = 5.92, SD = 0.80), achieved significantly higher ratings as well, t(41.89) = 8.46, p < 0.001. Finally, when looking at the

Discussion sections only, the sustainability students (M = 26.26, SD =2.38), compared to the environmental issues students (M = 20.38, SD = 3.05), also achieved significantly higher ratings, t(35.58) = 7.04, p < 0.001. However, similar to the IRR test results above, the trends differ at a more granular level, with some mean ratings on individual RLF criteria being significantly different between the two groups of reflections and others not significantly different. The full results can be seen in Table 6.

These findings suggest that RLF categories of Connection to Academic Theory, Relating to Other Contexts, Personal Thoughts and Feelings, Cause and Effect Relationships and Other Possible Responses are significantly less likely to be demonstrated in written reflections if their student authors had not been guided to include them. Furthermore, these findings support others who advocate for guided reflection, rather than assuming that deep reflection is an inherent skill.

Table 6. Results of t-tests

RLF Category	p-value	RLF Section	p-value	RLF Total	p-value
Temporal Progression	0.1194	Recount	< 0.001	RLF Total	< 0.001
Important Aspects of the Experience	0.8716				
Connection to Academic Theory	< 0.001				
Relating to Other Contexts	< 0.001	Discussion	< 0.001		
Personal Thoughts and Feelings	< 0.001				
Cause and Effect Relationships	0.0386				
Other Possible Responses	0.0007				
Planning and Future Practices	0.2915				

Applying a 95% confidence interval, assuming non-equal variances, and signalling that the variables were independent. Rejecting the null hypothesis of equal mean values at p-values less than 0.05

Discussion, Limitations, and Future Research

From this study, three themes have become apparent that are worthy of discussion and future inquiry – the challenge of training raters, the role of past reflective experience, and the impact of prompting questions.

The Challenge of Training Raters

This study brought to light the challenge associated with training raters to the degree of 'very good' or 'excellent' agreement. As researchers, we went to great lengths to test at the most granular level for rater agreement, while such a level of rigour is not practical in typical course. Furthermore, through our investigation of similar studies demonstrating high estimates of

interrater reliability, it is apparent that researchers go to greater lengths to ensure raters are highly trained and in agreement about their evaluation strategies prior to proceeding with their analysis (Carter, Creedy, & Sidebotham, 2017; Gadbury-Amyot, Godley, & Nelson Jr., 2019; Gadbury-Amyot & Overman, 2018), use small reflection samples (Carter et al., 2017), and employ use of expensive technology, such as video recorders (Britton, Simper, Leger, & Stephenson, 2017), to improve accuracy of their evaluations. These research strategies are obviously much different from what most course instructors are reasonably able to do within their course.

Although our findings too suggest that the RLF can be used for multiple raters, Steven (2004) reminds us that "[i]nterrater reliability refers to the level of agreement between a particular set of judges on a particular instrument at a particular time. Thus, interrater reliability is a property of the testing situation, and not of the instrument itself". For this reason, we intentionally aimed to simulate a situation similar to that of how a typical course would operate. The raters had been previously trained as part of their role as course teaching assistants and were asked to re-acquaint themselves with the RLF Guide and to have the rubric on hand during their evaluations. We avoided the urge to conduct extensive training, even though it would have likely improved the results of our study. As such, although the tests of interrater reliability were good in aggregate, there were significant differences at granular level of evaluation. Although we believe that agreement on the final grade is of greater importance for academic purposes, it is the reality that students likely receive less consistent feedback as it relates to their ability or inability to demonstrate specific cognitive processes, perhaps limiting their ability to learn and grow. Future studies could investigate effectiveness of rater training, with a focus on ensuring efficiency and accurate student feedback.

The Role of Past Reflective Experience

Within the Materials section, we noted that, of the 24 sustainability students, 19 had used the RLF for a reflection in a previous class and all but one student had experience with reflection during their university experience. Because this variable was not controlled for and we do not know if the environmental issues students also had prior experience with reflection, the higher grades could be attributed to experience. It is important here to differentiate that experience is not always equal. Gadbury-Amyot et al. (2019) who studied a cohort of predoctoral dental students found that after eight years of higher education and having had courses that asked students to reflect through their learning portfolios, 70% of the students' summative reflection assignments were rated at a level two or three of the researchers' five-level rating scale. Similar results were identified by Liimatainen, Poskiparta, Karhila, and Sjögren (2001) during a three-year longitudinal study. Gadbury-amyot et al. (2019) conclude that they mistakenly assumed that experience alone would be sufficient and made recommendations to include formal guidance and training into their curriculum. Future studies could control for formal experience and training to determine the effect that it has on students' ability to use and employ higher-order thinking as well as the metacognitive skills to create a deep, free-form reflection on their learning.

The Impact of Prompting Questions

In this study, prompts are shown to be effective at encouraging students to demonstrate their higher-order cognitive skills, and they seem to be widely used in practice (Brail, 2013; Burrows, 1995, referencing Johns (1994); Colley, Bilics, & Lerch, 2012). While the sustainability students were evaluated significantly higher, on average, in both the Recount and Discussion categories, there were specific RLF components within each category whereby the environmental issues

students scored higher than the sustainability students. While their mean evaluations were not significantly different, it is interesting that environmental issues students gave highly detailed accounts of their experiences and their actions, which resulted in higher average scores for RLF component of Temporal Progression. Also, and again not significantly different, the environmental issues students received higher average evaluations for the RLF component of Planning and Future Practices, demonstrating Bloom's Taxonomy's highest-order cognitive process, *create*. These were two areas whereby the students were given explicit guidance in the rubric, which outlined, "[a] detailed description and/or calculations about each action completed" and within the homework questions, which asked, "Do you plan to continue with any of the changes made during the lifestyle project? Why and how?" and "Are there changes you made that you don't plan to continue past this week? Why?" Similarly, the RLF components that the environmental issues students scored significantly lower on were not prompted through their rubric or homework questions. Specifically, the environmental issues students were significantly less likely to connect their experiences to theory, or what they were learning in class; relate their learning experience to what they knew from other contexts or experiences; and consider other possible responses, or ways of doing things differently. On the whole, to extend their learning to include information from outside of their lifestyle challenge experiences were not guided by the course instructor. As such, the students did not leverage those ways of thinking. In her discussion about the learner's conception of the learning tasks, Moon (1999) suggests that "for many learners, learning is conceived as a broad range of superficial knowing, not the higher education conception of knowledge as deep and applicable understanding" (p. 132). It is by no means our intent to suggest that all instructors prompt or guide students to incorporate all ways of thinking in one reflection assignment, but rather to highlight the impact that instructor guidance can have

on students' ability to demonstrate their cognitive skills. We recommend that educators align their course reflection assignment with their course-specific learning objectives, while also recognizing that the reflection assignment is likely not the only method of evaluation within the course. For example, if other course assignments assess students' academic writing, the instructor can choose to relax those requirements during the reflection. As such, and given the RLF's flexibility and ability to capture a wide array of demonstrated cognitive processes, the reflection assignment can be used as a way to fill gaps in evaluating specific learning outcomes. As indicated by Anderson et al. (2001), the gaps most likely exist in relation to higher-order cognitive processes, which are found less often in learning objectives. Related to the point and example above, it is also important to consider that, with respect to complexity of reflection guidelines, there are arguments in favour of greater simplicity when introducing students under the age of 25 to reflection (Burrows, 1995).

Related to the discussion above, and taken from the previous study about students' perceptions of using the RLF (Whalen & Paez, in press), we were encouraged to hear that students recognized that the RLF influenced their 'ways of thinking'. Such metacognition enabled them to access those ways of thinking to reflect, think critically, and tackle complex challenges. These comments can be considered in relation to deep learning, as described by Moon (1999):

> "The representation of surface learning, without further processing, draws on the isolated 'files' – at the time of learning, links have not been made with other ideas and areas of knowing. The representation of surface learning is of bits of information that may be recalled, but do not demonstrate a coherent form, nor substantially relate to previous knowledge. Deep learning, on the other hand, can be represented in a coherent form because

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the ideas themselves are meaningfully related and the material is meaningfully related to a network of relevant ideas in a cognitive structure" (p. 135).

Future studies could attempt to compare student perceptions and demonstrated abilities of using various reflection frameworks to determine the level of cognition, metacognition, and deep learning fostered from each one. Related to this theme is a limitation of the current study in that the comparison of reflections from the environmental issues course were guided with questions that led students to respond with plans and future practices, which was the RLF category associated with the highest cognitive process. While our discussion above suggests otherwise, the question remains whether or not the students would have included or even considered future plans and practices if they were not prompted to do so through their homework question.

Conclusion

In conclusion, the complex issues of sustainability will require the development and use of higher-order thinking skills, as well as the ability to learn through experience. As a key component to experiential learning, students must become equipped to reflect deeply and meaningful on their own by the time they graduate. Prompts and scaffolding are important and valuable steps in learning how to reflect, and it is the role of educators to both inspire students to want to continue learning and to help them develop the skills to do so.

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continue to support this research as returning evaluators. We would like to send our sincerest appreciation to Abbie Little, Coordinator of Academic Sustainability Programs at McMaster University, who provided creative vision and design expertise for the creation of the reflection handout, as well as provided valuable feedback on the various instructional resources that have been developed to support teaching students about and engaging them in reflection using the RLF. Faculty members of McMaster University's School of Geography & Earth Sciences have been a source of guidance and valuable feedback since inception of this study, particularly Dr. Maureen Padden and Dr. Carolyn Eyles.

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Chapter 5: Conclusions

This thesis described what I think of as my journey of inquiry about the role of reflection in learning; what makes a high-quality reflection; how educators guide, assess, and evaluate students' reflective learning; students' perceptions of reflection; and students' demonstrated abilities for reflective learning. In this conclusion I will summarize the main findings and ideas on how this research could be extended.

Summary of Findings

Even at an early stage of research on this thesis, I discovered that theory and practice do not always align, and that what works for one educator and their students does not necessarily work for another. Chapter 2 was motivated by my unsuccessful search for an existing reflection framework that could be used for the purpose of the new courses offered by the Academic Sustainability Programs Office. The reason for the failure was not that frameworks did not exist or had been used by others. Rather, it was because I was unable to effectively use them myself to achieve the outcomes I was striving for. This realization led to the grounded theoretical approach described in Chapter 2, which eventually produced a new reflection framework. After extensive study of student reflections, then-current literature, and many years of real-world trial and error, the outcome of this work was the development of the Reflective Learning Framework. This framework has now been successfully used by over a dozen educators in more than 20 university courses in disciplines including Business, Science, and Engineering, on topics ranging from scientific research, to leadership, and to statistics. The RLF is aligned with Bloom's Taxonomy and focuses on guiding students to use and demonstrate higher-order cognitive skills. An important aspect of developing the RLF is that it opened up new opportunities to explore its effectiveness in supporting student learning.

In reflecting on what I meant by 'effectiveness in supporting student learning', it was clear that I was most curious and concerned about students' perceptions of using the RLF. In Chapter 3, I interviewed students following a third-year sustainability course whereby they used the RLF to create their final course reflection assignment. Given that I do not teach the students that I interviewed, I was pleasantly surprised with the number of students who participated in my study. I care about students and reflection, and those are the values I brought to my research. It is likely that my values were evident to my students, which may have encouraged them to take part and influenced how they engaged with me during the interview. I was deeply grateful for their insight, and what I perceived to be honesty and candour in sharing their perspectives on using the RLF. Through surveying and interviewing students, I learned that students see reflection as a tool to develop and use cognitive and metacognitive skills, and also as a tool to support knowledge retention and transfer. Furthermore, findings suggest how reflection as studied contributes to the acquisition of higher-order thinking skills required to address the complex challenges of sustainability.

While results of positive student perceptions of using the RLF were found, that was only one of the measures of success identified. The final questions for this thesis were about the effectiveness of the RLF to support students in applying and demonstrating their higher-order thinking skills. Through comparing two sets of student reflections, one that used the RLF and one that did not, a test of interrater reliability and a comparison of means were conducted. The results of this study demonstrate both reliability of the framework to be used by multiple raters common in many large courses as well as the significantly different reflection outputs from students who used the RLF compared to those who did not.

Following these findings, I am confident in the success in effectiveness of the RLF as a tool to guide, assess, and evaluate reflection through experiential education in university courses.

What we know so far, and what we need to learn

Some of the limitations of this framework can be describe by discussing what we know now and presenting some ideas on what we still need to learn through further study and investigation. It is useful to re-state that while this Framework has been used and studied for many years within McMaster's Sustainable Future Program and has been adopted by faculty members in other Faculties within the institution, the RLF has been studied in a relatively narrow academic environment. While this list is not comprehensive, these are the areas I feel most pressing and relevant for the continued enhancement and use of the RLF:

Training of Raters

We know that raters can be trained to use the RLF with good results, that they need to be trained to look for demonstrated abilities in line with the RLF criterial, and we also know that rater evaluation and feedback is quite impactful, especially regarding personal reflection assignments. Within our test cases (our courses), we hired TAs who have taken one or more sustainability course and done well academically. As such, what we do not know is what kind and how much training is required for new raters and when introducing the RLF for the first time. For example, will new raters easily grasp the concept of 'attributing one's thoughts and feelings' such that they can assess and provide feedback to their students? Our questions remain, how much and what kind of rater training is required?

Student Characteristics

We know that the RLF can be used in interdisciplinary, university classrooms without any obvious difference in student success. While we have not seen any noticeable differences in student grades or perceptions based on student academic background, we have not formally tested to see if this is indeed the case. Student characteristics that would be interesting to study include: age, gender, level of study, ethnicity, and academic discipline. If differences are indeed present, learning from students and modifying the RLF and the training resources would be a positive next step.

Conceptual Frameworks

We know that aligning the RLF with Bloom's Taxonomy makes it fairly seamless for educators to connect reflection to their course learning objectives, mainly because Bloom's Taxonomy is so widely used in academia. However, we also know that other conceptual frameworks exist. We have not formally consulted educators within or beyond McMaster to see if another conceptual framework would be more effective. We have also not considered other frameworks, based on the popularity of Bloom's Taxonomy. It should also be noted that there are pros and cons to each framework that should be considered. For example, early iterations of Bloom's Taxonomy were criticized for claiming a 'cumulative hierarchy' in that learners must master less complex cognitive processes before moving to the next most complex process (Anderson et al. 2001 p. 267). While this criticism has been addressed (see Anderson et al. 2001 p.267), critically evaluating the use of Bloom's Taxonomy as the most effective conceptual framework, in comparison to other conceptual frameworks would help to either solidify Bloom's Taxonomy for use in the RLF or support future iteration and modification.

Impact of Others

One persisting question is whether or not to explicitly ask students to reflect on teamwork, group dynamics, or the influences of other people during their learning experiences. There a few reasons why this question has persisted: it was a potential theme in the initial open coding process of grounded theory, as many powerful insights were demonstrated when students reflected on how their experience and learning were influenced by other people; all of our SUSTAIN courses include at least one group assignment, because we strive to provide student with opportunities for interdisciplinary communication and teamwork as part of their sustainability education; and I commonly receive questions from other educators about the importance of including themes of group work in the creation of their prompting questions.

While the 'impact of others' was a potential theme, it did not persist throughout the research process. Furthermore, when later aligning with Bloom's Taxonomy, there was not a strong link to a particular cognitive process. Educators are free to include such questions in their reflection prompts and/or communicate to students that they are welcome to include the impacts of others within their reflection, as appropriate. I am also confident that students will reflect on the impact of others if they feel it was valuable to their learning through the affective domain. In my experience, students do not hesitate to reference others in their reflections and there are many opportunities to make such references when following the RLF. What we do not know is to what extent all students feel comfortable expressing the impact of others, especially if they fear negative consequences to them or others. We know that reflection on how others impact our experiences is valuable to many learners, but we do not know if all students feel comfortable or safe reflecting on the breadth of their interactions. Asking students about their perceptions in an anonymous survey would likely provide sufficient indication.

Peer Review

We know that peer-review can be a valuable educational and learning technique. While we trialled a reflection peer-review activity multiple times throughout the iterative process of Framework development and testing, each time we experienced little success. Generally, students were asked to bring their penultimate draft reflections to tutorial and their TA would facilitate a peer-review workshop for student pairs. The intent was to encourage students to prepare their reflection in advance and with sufficient time to edit, introduce students to the RLF again both in detail and through practice, and to foster learning through the reading of and discussion about another student's reflection. While some students reported finding value in the activity, most did not. The TAs also reported a sense of low engagement by students during these tutorials.

Despite our lack of success with a peer-review activity, I am also cognizant of our exclusion of important components, such as associated grades for participation and investigating other and more engaging activities to foster meaningful peer-review. While we know that peer-review can be valuable, we do not know the most effective approach to support student learning about reflection. Attentive TAs have a good sense about the effectiveness of their tutorials at fostering engagement, and they are also the ones who often grade the reflections. While applying strategies from other successful peer-review activities would be a natural next step, also including TAs into even informal investigation about how to best support student learning and engagement through peer-review or other forms of peer-learning is another avenue for learning.

Perspectives of Unsatisfied Students

While we know that students who chose to participate in our study of student perceptions and who made their reflection assignments available for research felt positively in general, we do

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not know about the perspectives or demonstrated reflective abilities of those students who chose not to participate. A possible hypothesis is that they were unsatisfied with the reflection assignment and did not want to engage in the research for that reason. One option is to look to course evaluations for student feedback. However, in the year studied, only 33% of students completed the evaluation and none of them explicitly referenced the reflection assignment, or any other specific assignment for that matter. Furthermore, of the 24 comments, only 3 were overly negative. As such, this correlation between positive student feedback in the course evaluation and the positive response to the reflection assignment suggests that it is unlikely that only students with positive things to say self-selected into the study of reflection. While it is good practice to employ additional strategies to garner additional student feedback, greater participant in course evaluations does not guarantee that students will include their perceptions on the reflection assignment in great enough detail or quantity to support any meaningful investigation.

In a more recent study, not included within this thesis, we requested access to student reflections for research purpose. A key difference was that while the previous study asked students if they wanted to opt-in, the most recent study asked students if they wanted to opt-out. Since none of the students chose to opt-out, we have the ability to formally analyze reflections from a more fulsome range of students. The issue of learning about perceptions from students who, perhaps, did not have such a positive experience and who may not want to engage on such a topic is still a challenge to be tackled.

Perspectives of Instructors

I have been primarily focused on the development of the Framework within McMaster's Academic Sustainability Programs (ASP) Office and we know that students, in general, feel

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positively about the reflection assignment and the RLF. We do not know what instructors in the ASP department feel about the use of the Framework in their courses, mainly because we have never explicitly asked them. Although they are agreeable to utilize the Framework and were continually consulted about the use of the Framework in their courses, an obvious power relationship exists in that I am the department head, the creator of the Framework, and was using the RLF as the focus of my doctoral studies. As such, it is unlikely that the instructors would have come forward with concern unless they had strong disagreement. Additionally, the Framework has been employed and likely adapted for use by other instructors. Similarly, the perceptions of these instructors have never been sought or studied, but they provide significant opportunity for continued development of the Framework, guiding students in reflection, and adaptations for use.

Adaptations for Use

We know how the RLF works within the sustainability courses where it has been developed and studied, but we do not know the various and innovative ways it could be adapted or the broader contexts it could be adapted for. Related to the discussion above, a natural next steps could be to learn from those instructors from other disciplines who are already using the Framework. For example, we know that one statistics professor utilized the RLF in his fourth-year course during transition to online teaching during COVID-19, which was a replacement for the planned exam in traditional format. The professor prompted the students to apply a concept from class to their learning. The innovative reflection prompt developed by the professor provided an example of how the cognitive process category of *Apply* (Anderson et al. 2001) could be included in the RLF. The *Apply* category is the only cognitive process category not include in the RLF. However, in the example provided, the RLF could be adapted to include and

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value students' ability to apply their conceptual knowledge through reflection. This is one potential adaptation, and there are many more to still be discovered. It is our intent to encourage use and development of the RLF within and beyond academia to see where and how it can be adapted. Of particular interest is to study application of the RLF in different forms and levels of education, professional practice, as well as geographic locations and cultures.

Contributions to the Discipline

Through this thesis, with a focus on reflection as a tool to support experiential learning, I answered my over-arching, two-part research question, which was, "*what is the role of reflection in learning through experience and how can educators guide, assess, and evaluate experiential learning through student reflection*". I learned that reflection is an integral part of the experiential learning cycle and to learning more broadly. I experimented with various reflection frameworks and ended up developing and testing my own framework.

Furthermore, my intent through this research was to contribute to our collective understanding of the role of reflection in students' learning through experience with a focus on developing educational and evaluative techniques to support students, educators, and administrators alike. Through much iteration, I not only developed a framework to assess and evaluate reflection, but, in response to student feedback, I also developed a variety of resources to support educators in teaching about reflection and to support students in understanding it and applying their learning. My findings that students have positive perceptions of using the RLF and that they can use it to produce high-quality reflective pieces demonstrates that the RFL and associated resources can be confidently employed and adapted by students, educators, and administrators alike.

Summary of Recommendations

Throughout my journey, I made recommendations based on the results achieved and my current thinking at the time. Some of the recommendations made were eventually followed through and addressed through subsequent work in this thesis while others provide direction to paths that are currently uncharted.

In Chapter 2, following the development of the RLF, I recommended creating resources for interacting with the Framework that were 'engaging, interactive and enjoyable for students and educators'. During the years that followed, and with the help of my colleagues, I enhanced the RLF Guide, created an attractive reference in the form of a two-page handout, developed an in-person workshop, and an online video workshop. Although development has taken place, there is still much more that can be done in this regard. Also within Chapter 2, I brought up questions of interrater reliability, which I addressed in Chapter 4. Given that interrater reliability is also contextual and specific to the situation and raters (Steven, 2004), replication in different settings would contribute to our understanding and confidence of the findings. Finally, I stated my interest in a longitudinal study of groups of students throughout their undergraduate, and possibly graduate, career and beyond university to determine if reflection, as an element of experiential learning, inspires a desire for continued learning. It is worth mentioning here that I did survey my student participants about the impact that experiential learning and reflection each had on their desire for continued learning. I was not surprised to find that the results were quite positive. Due to the likely influence of social desirability bias (Nederhof, 1985) and because peoples' predictions of their future behaviour is unreliable (Poon, Koehler, & Buehler, 2014), I chose not to invest time in analyzing that data. Rather, a longitudinal study would more effectively respond to such questions.

In Chapter 3, I made two recommendations for future research. My first recommendation was to complement our study of student perceptions with an observational study of demonstrated reflective skills, which was addressed in Chapter 4. My second recommendation was to identify ways to adapt the RLF so that it was less resource-intensive for educators to use while also achieving the learning benefits to students.

In Chapter 4, I brought up three themes that were worthy of discussion and future research. The first was about the challenge of training raters to the degree of 'very good' or 'excellent' agreement. I recommended that 'future studies could investigate effectiveness of rater training, with a focus on ensuring efficiency and accurate student feedback'. The second theme was about the role that experience with reflection played in impacting a learner's reflective abilities. Although the literature claims otherwise, findings from student interviews and, possibly, evaluations of their reflective writing from Chapters 2 and 3 respectively suggest that experience with the RLF may enhance their reflective abilities. This factor was not controlled for and presents an opportunity for future study to determine the effect that experience has on students' ability to use and employ higher-order thinking and metacognition to create a deep, free-form reflection. Finally, the third theme was about the role of prompting questions and their effectiveness at encouraging students to demonstrate their higher-order cognitive skills. I recommend that future studies could compare student perceptions and demonstrated abilities of using various reflection frameworks to determine the level of cognition, metacognition, and deep learning fostered from each one.

Concluding Thoughts

In addition to the many recommendations for future research presented within each chapter above, I want to leave one additional recommendation for consideration as a way to

conclude this document and close off this current phase of my learning journey on this topic. I also want to preface that this recommendation is influenced by having to transition all courses to an online format as a result of the COVID-19 global pandemic. During this process, our approach to teaching and the way we interact with our students had to change. We no longer see and connect with our students in person and our abilities for back-and-forth dialogue have been altered. This brings us back, full-circle, to the phase of my learning journey when the RLF was not 'working' the way I had hoped it would. The challenge was, in many ways, stemming from our ability to connect with students in a way that was effective for them. It was not until I listened to my students and created a number of resources to support them that I felt a shift in effectiveness of the RLF. At this time, I am most curious about how our instructional resources will transfer and continue to be effective in an online environment. Particularly, some questions include: how will students' connection to their instructors be different, will a change in the level of trust and rapport alter the output of student reflections, and what reflection resources will be most valuable to students in an online learning environment? Although it was created as a result of student interviews, the RLF Online Workshop YouTube[4] video has been referenced by many students. It has been watched over 377 times at the time of writing, which was over a period of about six months. Students described to me that the value of the video is as a refresher from what they learn during the in-person workshop, citing that it is the opportunity for dialogue, to ask questions right away, and to learn from their peers that is the true value of the workshop. There is no doubt that transitioning to online learning environments will have significant impacts on education in many ways, and I am particularly interested in how guiding, assessing, and evaluating student reflections will be different in this changing environment.

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[4] Video accessed at: https://www.youtube.com/watch?v=WFolTC5ETWM

In conclusion, it is my hope that this work will be valuable to students, educators, practitioners, and administrators alike. I hope the content within this thesis will provide insight on the role of reflection in experiential learning within an academic context. And finally, I hope that you, as a reader, experience this work as prime an example of the role of reflection in learning through experience.

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