MAKERMINDS:

AN EXPLORATION OF MAKING & MINDFULNESS PEDAGOGIES

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Abstract

In this doctoral research, I explore how making and mindfulness pedagogies interact when carried out in a single curricular intervention ('MakerMinds') and, in particular, how making works to engage students in mindfulness content and encourage their independent use of mindfulness tools. Using an ethnographically informed approach to research, I report on the experiences of 24 grade four students in 'MakerMinds,' an eight-week long school-based program blending mindfulness training with maker education implemented at a local elementary school in April and May of 2019. As mindfulness has been used for several decades in clinical and non-clinical settings to promote mental health, there now exists an extensive peer-reviewed empirical literature on the many potential benefits of mindfulness-based programs. Schools provide an ideal venue through which to promote mental wellness, and currently there is increased interest among educators and administrators in providing mindfulness-based programming within school contexts. However, related research with school-aged children is limited and the problem of how to engage them fully in mindfulness programming remains open. The purpose of MakerMinds is to engage young students in mindfulness by integrating mindfulness content with the constructionist approach to learning found in makerspaces. Weaving together these disparate pedagogies challenges traditional mindfulness training methods, immerses students in deeply creative work, and encourages them to practise using mindfulness tools while making life-sized human models that both reflect and develop their understanding of how those tools work. Qualitative data from multiple sources

revealed a range of positive responses to the program, as well as a number of insights into the potential benefits of this unique combination. The program was successful in engaging students in mindfulness content and encouraging their application of mindfulness tools as needed in their daily lives. It also positively impacted their conceptual and experiential knowledge of mindfulness and helped students to develop an agentic awareness of themselves as persistent, problem-solving makers and nascent mindfulness practitioners. I conclude this dissertation with a discussion of the program's limitations and the challenges of successfully implementing makerspace pedagogy and mindfulness training in any school setting.

Dedication

To my Mum and Dad,

for love and strength and laughter,

and for always knowing where the bright side is.

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Chapter One: Introduction

Currently, in spaces all over the world of various sizes and configurations —

from cramped garages to airy warehouses, from museums and community centres to

libraries and schools — people are joining together around a common interest in

exploring, inventing, creating, and building. They solve problems, large and small; they

share skills and materials and solutions; they solder and sew; they paint and 3D print;

they design and disassemble; they connect circuits and write code. For some,

makerspaces evoke memories of quilting circles, crafting guilds, or grandparents'

workshops. But these are 21st century workshops, usually — though not always —

hooked up to the latest technological advances in digital media and construction.

The maker movement has been gaining momentum ever since MIT's Neil

Gershenfeld and his colleagues established the first personal "Fab Lab" in 2001,

following on the broad-based popularity of a course Gershenfeld created and taught

called "How to Make (Almost) Anything" (APS News, 2006). More recently, this

movement has made headway into public educational settings with makerspaces

proliferating in elementary, intermediate, and secondary schools especially in North

America. Often this means outdated school libraries are upgraded – or even completely

renovated – to merge the traditional with the contemporary. In these

library/makerspaces students can access information, check out books, and also explore

a range of technologies all in the same place. The aim is to provide the space, materials,

and tools for students to move beyond conventional approaches to learning. Instead,

they (voluntarily or as part of a mandated curriculum) embrace simple to complex

building projects that require creative thinking, problem-solving, tinkering, and engineering. As two teacher-librarians and making enthusiasts put it, these are spaces where students "invent, share skills, put heads together to question and inquire, fix, reinvent, create, explore, and wonder" (Daley & Child, 2015, p. 43). Research into this contemporary maker movement spans less than two decades and, despite the growing interest in school-based makerspaces, studies related specifically to makerspace pedagogy are limited.

A similar situation exists in the realm of school-based mindfulness training. Though there are growing efforts to introduce mindfulness-based programs into schools, there is a paucity of research related to mindfulness training with children and youth. Derived from centuries-old Theraveda Buddhism (Hahn, 1976), mindfulness is generally conceived as a way of being that involves "paying attention … on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment" (Kabat-Zinn, 2013, p. 145). A majority of current programs that train people in this approach to living can be traced back to the work of Jon Kabat-Zinn, founder of the Mindfulness-Based Stress Reduction (MBSR) program at the University of Massachusetts Medical Center in 1979. Kabat-Zinn's work using mindfulness training to help patients cope with chronic pain laid the foundation for a secular MBSR program designed for use in clinical settings. This program has since been the subject of numerous research studies linking mindfulness training with positive physiological and psychological effects, including improvements in stress-related illnesses and the

promotion of mental well-being (Gouda et al., 2016; Grecucci et al., 2015; Kabat-Zinn, 2013; Meiklejohn et al., 2012; Paneduro, 2016).

Mindfulness training programs have become an increasingly popular method of promoting mental wellness in Western secular settings, including schools. Related research conducted with young people is extremely limited, however, and there are only a handful of mindfulness programs being studied in school settings (Burke, 2009; Gouda et al., 2016). These promise a range of psychological, social-emotional, and cognitive benefits to students (Beauchemin et al., 2008; Burke, 2009; Flook et al., 2010; Gouda et al., 2016; Meiklejohn et al., 2012), yet they tend to achieve a small number of their desired outcomes (Burke, 2009; Greenberg & Harris, 2012; Zenner et al., 2014).

One issue raised in the literature is that these programs often struggle to fully engage the interests or attention of many young people (Britton et al., 2014; Maloney et al., 2016; Milligan et al., 2013). This is perhaps not surprising given the abstract, rather intangible nature of the core content of any mindfulness program, in addition to the necessary elements of silence and stillness that might be challenging for some children to embrace. In an attempt to address this concern, I have adapted the pedagogical approach commonly used in MBSR and other mindfulness programs[1] to better meet the particular educational needs and interests of children. Indeed, there are currently no programs in the literature that approach the core content of mindfulness training using what we currently understand about the effectiveness and appeal of student-led,

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[1] There is a more detailed explanation of the 'classical' or traditional elements of MBSR and other mindfulness training programs in the Literature Review in chapter two.

project-based, and hands-on constructionist approaches to learning like those found in makerspaces (Blikstein, 2013; Halverson & Sheridan, 2014; Sheridan et al., 2014). In this dissertation, I have therefore attempted to create and implement an engaging mindfulness training program for young students by interweaving the disparate pedagogies of mindfulness and making. As an initial exploratory study into this unique curricular intervention, the goal of my research is to discern how these pedagogies interact when carried out in combination.

Mental Wellness in Children and Youth

In 2013, the Ontario Ministry of Education released a draft document, *Supporting Minds: An educator's guide to promoting students' mental health and well-being* to address a troubling gap in the public education system. At that time, the number of children and youth diagnosed with a mental health disorder in Ontario was about one in five (Ontario Ministry of Education, 2013b). South of the border, the situation appears to be similar: an out of date U.S. Surgeon General's report from 2000 notes that one in five young people are significantly impaired in their day-to-day functioning by mental health issues (U.S. Public Health Service, 2000) while adolescence is known to be the most common period for their onset (Gouda et al., 2016; Kessler et al., 2005; Lee et al., 2014; Paus et al., 2008). The World Health Organization (2018a) states that, globally, half of all mental health conditions begin before the age of 14. Of the young people who receive a diagnosis, most are dealing with an anxiety-related issue (Ontario Ministry of Education, 2013).

Though everyone experiences different levels of anxiety from time to time — and anxiety itself is considered to be an ancient physiological mechanism connected to survival (Marks & Nesse, 1994) — young people diagnosed with a disorder of this sort are those whose normal functioning is impaired. For these students, persistent and intense feelings of worry "can have a paralysing effect, disrupting [their] engagement in classroom activities, learning potential, performance, and social relationships" (Ontario Ministry of Education, 2013, p. 28). Social isolation is prevalent amongst youth with mental health disorders (World Health Organization, 2018a) and can exacerbate issues like anxiety and depression, catching sufferers in a downward spiral from which it becomes ever more difficult to escape. At the same time, teachers and school administrators lack training in identifying anxiety-related behaviours and providing essential support to students in need (Cohen, 2006).

Unfortunately, excessive wait times and prohibitive costs make access to treatment problematic (Centre for Addiction and Mental Health (CAMH), 2018). Worldwide, most adolescent mental health issues go undetected and untreated (World Health Organization, 2018a) while those young people who do seek help encounter a number of significant barriers. In Ontario, for example, the current wait times for psychological support through public services can be up to one year, and the cost for private therapy can be prohibitive (CAMH, 2018). This leaves many children and their parents alone to face these debilitating disorders. It is estimated that 75 percent of children with any kind of mental health issue do not receive specialized treatment (CAMH, 2018), while approximately 80 percent of children and youth suffering from

anxiety disorders do not receive any treatment at all (Merikangas et al., 2011). To make matters more challenging, the schools where young people spend most of their time can be a main source of stress in students' lives rather than a source of mental health support (Broderick & Metz, 2009; Cohen, 2006; Gouda et al., 2016; Ontario Ministry of Education, 2013). It is perhaps for all of these reasons that there is evidence of growing interest among Canadian educators in providing mental health programming (Whitley et al., 2013).

Support for All Students

Too many children and youth are struggling with stress, anxiety, and other mental health issues; this is abundantly clear. Many academic discussions about the need to address youth mental health begin and end here, with illness. They are framed within a deficit model that focuses upon what to do when students' mental health is lacking. This is indeed an important and necessary discussion.

In this dissertation, however, I am focusing instead on the need to promote mental well-being and foster mental wellness through universally applicable mental health programming in schools. It's worth pausing here to address these key terms. Throughout this dissertation, I use 'mental health', 'mental wellness', and 'mental well-being' interchangeably and my understanding of these terms aligns with Ministry of Education documents for the province of Ontario. A person with good mental health is "able to think, feel, act, and interact in a way that permits him or her to enjoy life while being able to cope with challenges that arise" (Ontario Ministry of Education, 2015, p.

39). It is "feeling well, functioning well, and being resilient" and it is essential to one's overall health and quality of life (Mental Health Commission of Canada, 2012, p. 22). These definitions remind the reader that it is not merely the absence of mental illness that makes a person mentally well and that mental health, like physical health, "exists on a continuum" that can be enhanced in a number of ways (Ontario Ministry of Education, 2013, p. 16).

Most people are quite comfortable viewing physical well-being this way, as an aspect of ourselves that can be improved through training programs. Indeed, most school systems encourage students to understand physical health, to promote wellness through exercise and good nutrition, and to strengthen their bodies through required physical education and health programs, intramural sports, extracurricular sports programs, and daily physical activity. Mental health, on the other hand, is far too often set aside until problems arise. Understanding the continuum of mental health has led to a "growing recognition" amongst government agencies and other stakeholders "that improving the state of mental well-being for the *whole* population brings social and economic benefits to society" (Mental Health Commission of Canada, 2012, p. 22, emphasis added). These benefits include reducing the prevalence of mental health issues and undermining the culture of stigma that so often prevents young people from seeking help (Children's Mental Health Ontario, 2018). As with physical education, schools provide the ideal location for universally applied training programs in good mental health, training that has the potential to positively impact all participants.

Mental Wellness and Social-Emotional Learning

The necessity of promoting good mental health amongst students is well-supported by the extensive literature on social-emotional learning (SEL). According to SEL scholars Weissberg et al. (2015), through social-emotional learning, "children and youth acquire and effectively apply the knowledge, attitudes, and skills necessary to understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions" (p. 1).

Within the framework of SEL, Taylor et al., (2017) identify several affective, cognitive, and behavioural competencies considered essential for student success in that they "promote well-being and protect against negative outcomes" (p. 1158). These competencies include self-awareness, self-management, and social awareness, all three of which are inextricably linked with mental well-being. Self-awareness, for example, requires the ability to recognize one's emotions; self-management involves being able to regulate those emotions and related behaviours; while social awareness consists in part of being able to take the perspective of others in order to effectively empathize and navigate social situations (Taylor et al., 2017).

Of the competencies listed under social-emotional learning, emotion regulation is regarded as particularly important. It is considered by SEL scholars to be a proficiency in the identification and management of one's own emotions that involves adaptability, productive expression, and resilience (Cole et al., 2004; Davidson et al., 2000). Emotion regulation is a "mainstay of mental health" (Broderick & Metz, 2009, p. 36) that is also a

key skill improved through mindfulness training (Arch & Craske, 2006; Robins et al., 2012; Roemer et al., 2015; Tang et al., 2016). Enhancing students' skills in these social-emotional competencies is "critical for healthy development and for counteracting the negative effects of exposure to risk" (Domitrovich et al., 2017, p. 2), while also improving both academic performance and behaviour (Taylor et al., 2017) and supporting "qualities of attention, reflection, and motivation that make learning effective" (Broderick & Metz, 2009, p. 36).

Programs that teach students social-emotional competencies serve as protection against serious emotional and behavioural issues while also promoting positive outcomes (Broderick & Metz, 2009; National Research Council and Institute of Medicine, 2009; Taylor et al., 2017). SEL scholars Domitrovich et al. (2017) note that the potential universality of such programs would, at the very least, lead them to be "successful in preventing later problems for a modest percentage of youth" and this would still "have a major public health impact" (p. 2). Greenberg et al. (2017) point out that a universally applied intervention promoting social-emotional competence within a school "may have strong and lasting effects not only by promoting healthy skills in particular children but also by changing the norms, skills, and attitudes of the entire [school] population" (p. 19). That is, such a program could reduce the stigma surrounding mental health issues and encourage students to seek help when they need it. If we recognize the universal value of personal strategies that cultivate mental wellness in the face of life's stressful situations (Ontario Ministry of Education, 2015),

then we must also recognize that schools are ideally placed to take a central role in teaching these strategies and fostering this well-being.

Schooling and Mental Health

Ideally, schools provide young people with a safe and supportive space, a haven in which to learn and grow but this is not always (or even often) the case. Schooling has long been criticized for the ways in which it undermines its own educative aims. Many of these issues arguably create an environment more conducive to mental ill-health than to well-being. Over a century ago, progressive educator John Dewey decried schooling's disconnection from working and learning in daily life, a disconnection still evident today. He called this the "great waste … [that] comes from [the child's] inability to utilize the experiences he gets outside of the school in any complete and free way within the school itself" (Dewey, 2001, p. 46). He further worried that "the only measure for success is a competitive one, … a comparison of results … to see which child has succeeded in getting ahead of the others in storing up … the maximum of information" (p. 11). Decades later, Freire (2000) similarly condemned what he called "the banking concept of education" in which "the teacher issues communiques and makes deposits which the students patiently receive, memorize, and repeat" (p. 72).

Such methods are common in today's schools. They elevate the teacher as repository of all required knowledge and diminish students as passive recipients of teacher-delivered content. It is a lesson in stultification as "one intelligence is subordinated to another" (Ranciere, 1991, p. 13). Under these conditions, students learn

that they are unqualified to seek their own knowledge or even to determine what knowledge to pursue. Instead, they move year after year through sets of ministry-approved curricula of testable content all separated into disconnected subjects and units. For some students, this system is best likened to what Ivan Illich (1970) thought of as an educational machine, one that teaches "conformity to rules and memorization of a set body of knowledge without necessarily learning or understanding — which is then measured as an end in itself" (Gauntlett, 2011, p. 163). Rather than providing havens in which to learn and grow, these fundamental issues of schooling can impoverish relations between students and their own learning, leaving them bored and disempowered.

Add to these issues overcrowded classrooms filled with challenging social interactions and overburdened teachers struggling to pack in curricula with too many students and not enough time. Even "break-time" can mean chaotic lunches in unsupervised classrooms, in hallways, or in gymnasiums doubling as cafeterias. The increasing pressure of accountability measures and the school system's "overly high demands of efficiency and effectiveness" (Gouda et al., 2016, p. 5) contribute to the stress.

Indeed, our schools must now contend with a collection of pressures unheard of when the system was first being formed (Broderick & Metz, 2009). "Modern schools," claim Gouda et al. (2016), "often constitute a source of stress and a miniature representation of an overbearing society's demands … instead of providing a space for personal growth, creativity, curiosity and learning" (pp. 1-2). Nor do students leave

their emotional struggles at the door when they enter classrooms; they bring with them "family-system disturbances, peer-interaction conflicts, socio-cultural components, and … physical and mental health risk factors" (Meiklejohn et al., 2012, n.p.). Children and youth who experience "family and neighbourhood poverty, parental unemployment, discrimination and social exclusion, [and] exposure to violence and trauma," are all particularly vulnerable to mental health issues (Ontario Ministry of Education, 2013, p. 15). These issues can then be exacerbated by school-related pressures, often resulting in difficult peer interactions and a reluctance to participate in classroom activities (Ontario Ministry of Education, 2013, p. 39).

Mental Health Programming in Schools

Currently, mental health education receives minimal attention in terms of programming in schools. In Ontario, for example, Ministry documents for grades one through eight suggest that mental health and emotional well-being "can be incorporated as part of each of the four health topics, as well as of learning across the curriculum" (Ontario Ministry of Education, 2015, p. 35) but a close reading of these topics reveals only one explicit reference to mental health. Under the topic of substance use, addictions, and related behaviours, students in grade eight should learn to "explain how stress affects mental health and emotional well-being, and demonstrate an understanding of how to use a variety of strategies for relieving stress and caring for their mental health" (Ontario Ministry of Education, 2015, p. 218). There is certainly evidence of growing interest amongst Canadian teachers in providing good mental

health programming (Whitley et al., 2013), but the dearth of explicit requirements in the most recent Ministry documents means that such programming is administered haphazardly at best.

Making and Mindfulness

It is because so many students struggle to cope with the multiple challenges of the public-school system that I would argue it is also the most appropriate place to implement a mindfulness program promoting mental wellness. As previously stated, there is an extensive peer-reviewed literature that demonstrates the many mental health benefits of mindfulness-based programs (Gouda et al., 2016; Kabat-Zinn, 2013; Meiklejohn et al., 2012; Paneduro, 2016). At the same time, combining this training with makerspace pedagogy disrupts traditional methods of training and schooling and has the potential to engage students deeply in building their own understanding of mindfulness. Placing such a program in a public school allows it to reach a diverse group of students, including those who might otherwise not be able to access mental health programming at all. Citing the work of SEL scholars Greenberg et al. (2017), Gueldner & Feuerborn (2016) claim that schools must "provide *all* students with effective instruction and support to mitigate risk behaviors and outcomes and enhance protective factors known to affect positive, overall development" (p. 165). Many students come from families that lack the time, financial resources, or even physical access to programs held outside of regular school hours at their home schools. A fear of stigmatization, particularly amongst peers, might also mean that students avoid signing

up for after-school or community-based programs having to do with mental wellness. Integrating this intervention into a regular school curriculum mitigates these issues and enables all students in a class to access it equally. This integration also works to destigmatize mental health issues within the school culture and normalize common stressors and worries by encouraging open discussion of both. Beyond this, carrying out a program of this nature within a school might well make that school a kinder, gentler space. For those students whose typical school experience is anything but health-promoting, this will be a welcome change. And perhaps its presence will encourage school administrators and teachers to integrate more programming of this kind.

Research Questions

As an initial exploratory study of a unique educational program, this dissertation takes an ethnographically informed approach to the following questions:

1. How do mindfulness and makerspace pedagogies interact when combined in a single curricular intervention?
2. How does the combination of mindfulness with makerspace pedagogies engage students in mindfulness training and encourage their uptake of mindfulness content?

I address these questions from the dual perspectives that I applied in creating the program itself. That is, without an existing accepted theory of mindfulness, I address the above research questions by applying the understanding of mindfulness detailed in

the first part of chapter two's literature review titled 'Why Mindfulness?'. At the same time, I address the questions from a constructionist perspective as detailed in both the second part of the literature review titled 'Why Making?' and in chapter three. In the 'Why Mindfulness?' section of chapter two, I describe a generally accepted definition of mindfulness and trace its Western secular history to the clinical work of Jon Kabat-Zinn beginning in 1979. I also delve into relevant literature — from the disciplines of psychology and health sciences in particular — to understand the physiological and psychological outcomes of mindfulness-based practices. I then include findings from educational researchers to discuss connections amongst mindfulness, emotional regulation, and metacognition. And I follow this with a discussion of the minimal existing literature on mindfulness research with children and youth. In the 'Why Making?' section, I begin by connecting current conceptions of making to the learning theory of constructionism, which I then build on to discuss the external artefact that is central to this approach to learning. I follow this with a history of making and a discussion of contemporary makerspaces and then conclude with an explanation of makerspace pedagogy. In chapter three, I explore constructionism more fully by connecting this learning theory to making, makers, and makerspaces. In the second part of chapter three, I explore similar components of mindfulness in order to highlight connections that were helpful in designing an integrated curriculum. In chapter four, I discuss the methodological approach applied to this research, including the importance of centering participants' voices and applying reflexivity to ethnographically informed work. I end this chapter by detailing the design of the curricular intervention itself and

my ongoing reflexivity in its implementation. Chapters five and six are dedicated to two separate sets of findings. The first set, in chapter five, leverages the ethnographic nature of this research to immerse the reader in thick descriptions of the program. Its purpose is to convey how different students engaged with the program differently. Chapter six is analytical rather than descriptive and focuses on findings related to the program's combination of making with mindfulness pedagogies. I conclude this dissertation in chapter seven with an exploration of its limitations and lessons learned about the challenges of implementing both mindfulness and makerspace pedagogies in a school setting. I now turn to the literature review in chapter two.

Chapter Two: Literature Review

Why Mindfulness?

Mindfulness and Mental Health

To understand the current popularity of mindfulness programs to promote mental health, one must turn to the work of Jon Kabat-Zinn who, as mentioned previously, founded the MBSR program at the University of Massachusetts Medical Center in 1979. It was Kabat-Zinn who separated the notion of mindfulness from its Buddhist framework in creating a secular program of classes aimed primarily at patients dealing with chronic pain (Bishop et al., 2004; Kabat-Zinn et al., 1987; Poulin, 2009). Though he acknowledges the contribution of Buddhism to his own work (Poulin, 2009), Kabat-Zinn (2013) also argues that mindfulness does not need the validation of a religion or a culture, but "stands on its own … as a powerful vehicle for self-understanding and healing" (p. lxii). For almost forty years, the MBSR program has trained practitioners to develop their capacity for mindfulness through an eight-week-long course involving intensive use of various meditation techniques. This program has been highly influential in a growing body of scientific research on the subject of mindfulness within medicine, as well as a large number of other disciplines, including the field of education (Kabat-Zinn, 2013). Indeed, numerous studies link MBSR with positive physiological and psychological outcomes, including improvements with stress-related issues like depression, anxiety, and panic attacks (Gouda et al., 2016; Kabat-Zinn, 2013; Meiklejohn et al., 2012; Paneduro, 2016).

It is important to note that much of the literature on youth mental health comes from the disciplines of psychology and health sciences and is the result of research in clinical settings. It is therefore written in medicalized language that is somewhat incongruous in the context of this study. Although I often use that medicalized language in this chapter, I do so only to explore the established efficacy of mindfulness training from the related clinically based research. As my own research takes place with students in a school setting, I will return to language more suited to educational studies in the chapters that follow.

There are myriad programs that could be described as Mindfulness-Based Interventions (Gouda et al., 2016), each with mindfulness training at its core. MBSR is just one particularly popular and successful approach. Another widely successful approach in the field of clinical psychology is Mindfulness-Based Cognitive Therapy (MBCT), first described as attentional control [mindfulness] training by Teasdale et al. (1995). This approach built upon MBSR to combine mindfulness training with cognitive behaviour therapy (CBT) in the development of a relapse prevention program aimed primarily at individuals suffering from major depression (Teasdale, 1999). CBT works to help participants challenge and change thoughts that lead to dysfunctional behaviours (Burns, 1999). MBCT, on the other hand, trains participants in mindfulness in order to bring a non-judgemental awareness to their own thinking and to perceive that thinking from a *decentered* perspective. This decentering refers to the view that thoughts are transitory events of the mind, an orientation which facilitates thought-

relabelling and restructuring of associated behaviours (Jensen, 2011; Paneduro, 2016; Segal et al., 2004; Skinner et al., 2012).

Dialectical Behaviour Therapy (DBT) is another approach from clinical psychology that employs mindfulness techniques to help individuals identify and describe emotional states (Baer, 2003; Burke, 2009; Linehan 1993; Poulin, 2009). These interventions — as well as a multitude of non-clinical examples — generally involve learning and practising various forms of meditation, principally concentrative meditation, in which an object of awareness is used to focus the attention, and mindfulness meditation which involves an awareness of all internal and external stimuli (Paneduro, 2016). Citing both Kabat-Zinn and Segal et al., Bishop et al. (2004) provide a particularly helpful description of this latter process:

> The client … attempts to maintain attention on a particular focus, most commonly the somatic sensations of his or her own breathing. Whenever attention wanders from the breath to inevitable thoughts and feelings that arise, the client will simply take notice of them and then let them go as attention is returned to the breath. This process is repeated each time that attention wanders away from the breath. As sitting meditation is practiced, there is an emphasis on simply taking notice of whatever the mind happens to wander to and accepting each object without making judgments about it, or elaborating on its implications. (p. 4)

Often, training in mindfulness involves listening to guided meditations (Kabat-Zinn, 2013) as well as more informal meditative practices that imbue everyday activities — like walking and eating — with mindful awareness (Meiklejohn et al., 2012). Another practice focuses attention on particular thoughts — such as gratitude, compassion, or empathy (Jennings et al., 2011). All of these approaches to meditation train the practitioner in greater emotional and attentional regulation through the ability to

"engage, disengage, and eventually accept as much as possible into the field of awareness with minimal elaboration of the experience" (Paneduro, 2016, p. 5). Despite a common misperception that mindfulness training programs teach the avoidance or suppression of thoughts and feelings, the opposite is in fact true (Meiklejohn et al., 2012). Mindfulness practitioners are encouraged to cultivate the ability to observe their own minds and to gently but consistently redirect attention to what is most salient in each moment (Kabat-Zinn, 2013). It is an experiential process, one that can best be understood through immersion in a personal practice. Like playing a sport or an instrument, "proficiency is cultivated through repetition" (Flook et al., 2010, p. 72).

What is Mindfulness?

Mindfulness has its roots in centuries-old Theravada Buddhism (Hahn, 1976). The word itself comes from Pali, a Buddhist canonical language of Northern India, combining *sati*, meaning 'awareness', and *samprajanya*, meaning 'clear comprehension' (Grecucci et al., 2015). Though the exact, nuanced nature of mindfulness is the subject of ongoing debate (Grossman, 2008), there is a general consensus to be found amongst scholars who agree that mindfulness is an awareness that emerges from bringing non-judgemental and focused attention to each moment of one's experience (Bishop et al., 2004; Broderick & Metz, 2009; Gouda et al., 2016; Kabat-Zinn, 2013; Lutz et al., 2008; Meiklejohn et al., 2012; Paneduro, 2016; Poulin, 2009; Shapiro et al., 2006). It is an "*awareness that arises by paying attention on purpose*" that is distinct from the act of thinking, instead being a powerful and "complementary form of intelligence" (Kabat-

Zinn, 2013, p. xxxv, emphasis in original). This awareness provides an interlude, a pause, in which a mindfulness practitioner might craft and carry out responses to events — including thoughts and emotions — rather than simply reacting to them. Though most commonly referred to as a state (Broderick & Metz, 2009; Grecucci et al., 2015; Kabat-Zinn, 2005; Napoli et al., 2005; Richart & Perkins, 2000; Shapiro et al., 2006), other scholars prefer to think of mindfulness as a 'capacity' (Creswell & Lindsay, 2014) or as a 'mode' (Bishop et al., 2004). These terms better capture the understanding that one can be trained in mindfulness as a psychological process to be, in a sense, turned on and used at will.

In 2004, Bishop et al. introduced a two-component model of mindfulness, the result of a widely collaborative effort to produce an operational definition that would encourage more rigorous testing of outcomes using randomized controlled trials. This definition recognizes that "mindfulness facilitates *self-regulation of attention* and a greater focal *orientation to experience*" (Paneduro, 2016, p. 4, emphasis in original).

Through mental training, practitioners are able to bring awareness (attention) to their thoughts and feelings and reflect upon them non-judgmentally (orientation), resulting in a "dispassionate state of self-observation … [that] introduce[s] a 'space' between one's perception and response" (Bishop et al., 2004, p. 232). On the one hand, "the self-regulation of attention … involves sustained attention, attention switching, and inhibition of elaborative processing" (Bishop et al., 2004, p. 11). On the other hand, the practitioner brings "a quality of non-elaborative awareness to current experience …

within an orientation of curiosity, experiential openness and acceptance" (Bishop et al.,

2004, p. 14).

Two years after this operational definition was introduced, Shapiro et al. (2006)

presented a model of mindfulness that likewise identifies the components (or axioms) of

attention and attitude — akin to Bishop et al.'s concepts of 'attention' and 'orientation'

— but also adds a third component of 'intention'. These are three interconnected

processes (Grecucci et al., 2015) with the axiom of intention thought to be the essential

'why' behind one's practice (Shapiro et al., 2006, p. 375).

Physiological Outcomes of Mindfulness Training

Many studies have focused on the effects of mindfulness training on chronic pain

and other physiological symptoms. Kabat-Zinn's MBSR program, for example, was

found to have positive results in terms of pain alleviation and the reduction of related

psychological suffering (Kabat-Zinn, 1982), while an early longitudinal controlled study

suggested these benefits persist in the long term (Miller et al., 1995). In 2014, Garmon et

al. reviewed 23 studies, including 13 randomized controlled trials, on the impact of

MBSR on pain and, although they determined there was not sufficient evidence that

MBSR reduces the intensity of pain, they did argue that the program aids sufferers in

managing their pain through improved mental health and coping skills (Paneduro,

2016). Other studies have linked mindfulness training with improvements in immune

system functioning (Barrett et al., 2012; Davidson et al., 2003), in skin conditions

amongst psoriasis patients (Kabat-Zinn et al., 1998), and in physical health symptoms in

cancer patients (Ledesma & Kumano, 2009). A number of researchers are exploring the biological mechanisms that connect mindfulness to human physiology. Creswell and Lindsay (2014), for example, posit that mindfulness works indirectly on physiological symptoms through a stress buffering system that affects two different pathways in the brain. One is a "top-down regulatory pathway" that works in the prefrontal region of the brain to inhibit stress activity and the other is a "bottom up" pathway that "reduces stress reactivity"[2] (p. 3).

Psychological Outcomes of Mindfulness Training

An overwhelming proportion of mindfulness research aims to measure its impact on a broad array of outcomes related to mental health and well-being. For example, studies have linked mindfulness training to significant increases in self-acceptance (Broderick & Metz, 2009), self-perception of physical health (Poulin, 2009), as well as empathy and compassion (Davidson et al., 2003; Shapiro et al., 2007; Shapiro et al., 1998). Mindfulness training is also associated with reduction of negative affect (Broderick & Metz, 2009), increases in positive affect (Davidson et al., 2003; Shapiro et al., 2007), significant reductions in stress (Gouda et al., 2016; Paneduro, 2016; Shapiro et al., 1998; Williams et al., 2001; Bruce et al., 2002), improvements in interpersonal problems (Biegel et al., 2009; Gouda et al., 2016), enhanced coping skills (Garland et al.,

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[2] For more on the neurobiological details of this hypothesis, as well as the neurobiology of stress responses, see Creswell, 2015; Creswell et al., 2014; Miller, Chen, & Cole, 2009.

2011; Garmon et al., 2014; Poulin, 2009), and overall improvements in well-being (Shapiro et al., 1998).

These and other mental health-related outcomes — including measures of anxiety and depression — are further supported by many recent meta-analyses. In 2010, for example, Hofmann et al. reviewed 39 studies of mindfulness training on varied clinical populations and found moderate effect sizes on both mood (Hedges's g=0.63) and anxiety (Hedges's g=0.59). Notably, these numbers increased when samples were limited to mood and anxiety disorders (Hedges's g=0.95 and 0.97, respectively).

In 2012, Eberth and Sedlmeir undertook a meta-analysis of 39 studies of mindfulness training on non-clinical populations. They found large effect sizes related to stress (d=0.78), well-being (d=0.80), and anxiety (d=0.64) but also noted that MBSR programs, in particular, appeared to be the most impactful on a range of wellness outcomes. Other studies have shown MBCT programs to be particularly effective in reducing anxiety for those with disorders of this kind (Evans et al., 2008) and in preventing depressive relapse for those who have experienced several major episodes (Ma & Teasdale, 2004; Segal et al., 2004). Also in 2012, Sedlmeir et al. reviewed 163 mindfulness-based intervention studies to find a medium weighted mean effect size (r=0.28) across 21 different categories of mental health-related dependent variables, including state anxiety (r=0.37), trait anxiety (r=0.32), and negative emotions (r=0.34). In 2015, Khoury et al. reviewed 29 studies of mindfulness-based programs with non-clinical populations and found large effects on stress, and moderate effect sizes related to anxiety, depression, distress, and quality of life. Earlier meta-analyses found both

moderate (d=0.54) effect sizes on mental health (Grossman et al., 2004) and large effect sizes on anxiety (d=0.70) and depression (d=0.84) across diverse populations (Baer, 2003).

Emotion Regulation and Metacognition

The connection between emotion regulation and mental wellness is well-established (Broderick & Metz, 2009; Corcoran et al., 2010; Grecucci et al., 2015; Meiklejohn et al., 2012; Shapiro et al., 2014). The effects of mindfulness training on emotion regulation are therefore of particular interest for this research study. As it is closely connected to emotion regulation, attentional control is another oft-studied outcome of mindfulness training that is of particular importance to this dissertation. In the two-component model proposed by mindfulness researchers Bishop et al. (2004), mindfulness leads to 1) self-regulation of attention — including sustained attention, attention switching, and the inhibition of elaborative processing; and 2) an open and accepting orientation that facilitates emotional awareness and regulation. In the three-component model proposed by mindfulness researchers Shapiro et al. (2006), mindfulness leads to self-regulation skills in 1) executive functioning — which involves attentional skills and reflection; 2) emotional regulation; and 3) perspective taking — which includes self-awareness.

Both of these models clearly propose that mindfulness develops the practitioner's ability to self-regulate both attention and emotions, and both suggest a reciprocal relationship between these functions, such that a facility in regulating one

predicts a facility in regulating the other. Outside of a mindfulness framework, emotion and attention are so intricately connected that it is difficult to think of disentangling them. When do we ever experience an emotion without also attending to it, or attend to any internal or external event without also reacting emotionally? This is, however, in large part what mindfulness training proposes to do. Mindfulness training is thought to empower practitioners to take a decentered perspective (Bishop et al., 2004) by attending to thoughts and feelings with a non-judgemental understanding of them as transitory events — to be engaged only by choice. At the same time, mindfulness training is thought to create space between one's awareness of the world and one's reactions to it, and it is in this space that emotion regulation can take place.

The research in this specific area is much more limited than in outcomes related to psychological symptoms and overall well-being. It is also less consistent. A number of researchers have found no substantial evidence of overall improved attentional control through mindfulness training (Anderson et al., 2007; Cusens et al., 2010; MacCoon et al., 2014; Ortner et al., 2007). Other researchers, however, have found that mindfulness training enhances attentional control, including sustained attention, orienting, attention switching, and inhibitory control (Chambers et al., 2008; Moore & Malinowski, 2009; Jha et al., 2007; Slagter et al., 2007; Tang et al., 2007). A number of researchers have also found that mindfulness training enhances emotion regulation (Arch & Craske, 2006; Robins et al., 2012; Roemer et al., 2015; Tang, Y.Y., Tang, R. & Posner, 2016), while Sedlmeir et al.'s (2012) meta-analysis of 163 studies found a small to medium effect size in emotion regulation.

It is also worth noting that some of the studies with negative results in terms of overall attentional control still found significant evidence of other important benefits. For example, in a randomized control trial comparing 39 participants of an MBSR program to a waitlist-control group of 33, Anderson et al. (2007) found no significant differences in non-directed attention, attention-switching, or sustained attention but did see a significant improvement in an object detection task which, the authors contend, is a specific kind of attention and something that requires present moment awareness associated with mindfulness training (Paneduro, 2016). Similarly, Cusens at al. (2010) found no improvements in sustained attention following a mindfulness-training program aimed at pain management, but they did show improved awareness of affect. Compared to the control group, the mindfulness participants showed a greater awareness of pleasant words during a modified version of the Implicit Association Test, an outcome that supports the connection between mindfulness and the ability to disengage from negative emotional stimuli (Paneduro, 2016).

Inherent in a state of mindfulness — and the key to understanding emotion regulation — is a specific mode of attention known as metacognition, or the cognition of one's own cognition (Flavell, 1979). Bishop et al. (2004) contend that mindfulness is a metacognitive process "since its evocation would require both control of cognitive processes (i.e., attention self-regulation) and monitoring the stream of consciousness" (p. 11).

To think about one's own thinking, to witness the workings of one's own mind, to experience thoughts as merely thoughts and not necessarily as reflections of reality,

to choose whether or not to engage each thought, and to be able to disengage from harmful thoughts — all of these are skills produced by the metacognitive aspect of mindfulness. And these skills have powerful implications for emotion regulation and therefore for mental health. In a randomized controlled trial on the effects of a mindful awareness program on children ages seven to nine, Flook et al. (2010) found improvements in metacognition, behavioural regulation, and specific aspects of executive functioning including children's "abilities to shift, initiate, and monitor" their attention (p. 79). The three-part practice of *initiating* attention to one's breath, *monitoring* that attention for signs that it has wandered, and then *shifting* attention back to the breath is central to any mindfulness training program (Flook et al., 2010), and it is essentially training in metacognition (Corcoran et al., 2010; Grecucci et al., 2015; Shapiro et al., 2014; Teasdale, 1995; Teasdale et al., 2002). Strengthening these metacognitive skills helps to activate the brain's top-down regulation of emotions through a cognitive reappraisal mechanism associated with mindfulness (Creswell et al., 2014; Grecucci et al., 2015).

In Shapiro et al.'s (2006) model, this cognitive reappraisal mechanism is called "reperceiving", a term that refers to the way mindfulness involves an observational view of the self, a separation between one's self and one's thoughts that allows them to be consciously reframed (Grecucci et al., 2015). The key to emotion regulation lies in this cognitive attention to, and control of, reactions to thoughts and experiences, "allowing the [practitioner] to skillfully respond to situations that provoke emotional reactions" (Bishop et al., 2004, p. 15). Such a state stands in opposition to *mindlessness,* in which

reactions are automatic, and thoughts can be repetitive, intrusive, and the cause of great distress (Grecucci et al., 2015; Kabat-Zinn, 1994).

A second mechanism involved in emotion regulation is thought to be rooted in the cumulative effect of mindful experiences. Repeated exposure to non-judgmental reactivity, as well as to the transient nature of thoughts and emotions, works to alter one's perspective on the self (Hölzel et al., 2011). In this way, emotion regulation stems from an intimate familiarity with stress-free (or even positive) reactions to all experiences, including those previously considered to be negative (Grecucci et al., 2015). This is thought to be a "bottom-up" process (as opposed to the previously mentioned "top-down" process) in that it works to reduce the reactivity of stress-producing regions of the brain (Creswell & Lindsay, 2014, p. 3). Research employing neuroimaging technology lends support to this notion by showing reduced activity in areas of the brain, like the amygdala, typically associated with stress responses (Hölzel et al., 2011). Because it takes time and experience to impact this mechanism, it is a process seen more in practitioners with long-term mindfulness experience rather than in beginners (Grecucci et al., 2015).

Mindfulness Research with Children and Youth

Mindfulness research with children and youth is much more limited than with adult populations. Though overall findings are promising (Burke, 2009; Gouda et al., 2016; Semple & Burke, 2019), several recent meta-analyses of mindfulness-training programs with young people have cautioned that empirical evidence of efficacy is

somewhat lacking in this nascent field due to a number of constraints, including important ethical considerations inherent in working with young people, in obtaining accurate measurements and control data, and in the sheer variety evident in the programs studied (Burke, 2009; Carsley et al., 2018; Greenberg & Harris, 2012; Semple & Burke, 2019; Zenner et al., 2014).

These same researchers also express optimism about the opportunity such programming represents to support the mental health and well-being of students. The MindUp program, for example, is designed for teaching mindfulness to elementary school students with the aim of promoting prosocial behaviours and supporting social-emotional well-being (Hawn Foundation, 2011). Fifteen 30-minute lessons focus on internal and cognitive experiences, in addition to time spent practising gratitude and conducting acts of kindness. Along the way, students engage in traditional mindfulness activities like mindful eating, listening, smelling, and movement (Maloney et al., 2016). Inner Kids is a mindfulness-based program for children ages seven to nine that uses games and exercises to promote awareness of the self, awareness of others, and awareness of the environment (Flook et al., 2010). There are 16 sessions of 30 minutes' duration, each divided into a brief period of sitting meditation, followed by activities linked to the session's objective, and ending with a body scan or other form of meditation.

A third example is called Learning to BREATHE, a mindfulness-based program designed for adolescents and aimed at promoting inner strength and emotional balance. Through six sessions, students learn to understand their thoughts and feelings and to

use mindfulness to manage negative emotions (Broderick & Metz, 2009). Each of these examples has been shaped in certain ways to adapt adult-centric mindfulness-based content to meet the perceived needs of children, and all of them have been successful on a number of outcomes (Broderick & Metz, 2009; Flook et al., 2010; Maloney et al., 2016).

Indeed, numerous studies of these and similar programs reveal a range of psychological, social-emotional, and cognitive benefits for both elementary and secondary school students (Meiklejohn et al., 2012). Studies have connected mindfulness training programs for children and adolescents to improvements in anxiety and stress, in mood and overall well-being, in social skills, in attentional and executive functioning skills, and in emotion regulation (Beauchemin et al., 2008; Black et al., 2009; Broderick & Metz, 2009; Flook et al., 2010; Gouda et al., 2016; Napoli et al., 2005; Semple et al., 2005; Semple et al., 2009; Schonert-Reichl & Lawlor, 2010; Zylowska et al., 2008). However, Broderick and Metz (2009) caution that "[t]he work of bringing mindfulness to children and adolescents in schools is just beginning" (p. 43) and that there are still complex questions to be considered about how best to translate mindfulness content and activities for use with children (Jennings et al., 2011).

Arguably, it remains difficult to fully engage young people in what are often considered to be uninteresting — even boring — aspects of mindfulness training (Britton et al., 2014; Maloney et al., 2016; Milligan et al., 2013). Maloney et al. (2016) write that "[e]ncountering boredom seems to be part and parcel of mindfulness practice" (p. 328). There are certainly no programs evident in the literature that approach mindfulness training for young people using what we know about the

popularity and effectiveness of school and community makerspaces, and the student-led, project-based, hands-on learning they engender. Thus, in an attempt to address the important question of how to teach mindfulness in a way that fully engages young people and promotes their mental health, I turn to makerspaces and the constructionist approach to learning they embrace.

Why Making?

Constructionism

So many scholars trace current conceptions of the *makerspace* back to Papert's constructionism (1991) that it seems like an appropriate place to begin any discussion of *making* (Blikstein, 2013; Halverson & Sheridan, 2014; Litts, 2015; Martinez & Stager, 2013; Sheridan et al., 2014). In *The Children's Machine*, Papert (1993) roots his work in a total dissatisfaction with school's imposition of "a single way of knowing on everyone" (p. 6) that does not correspond to how people naturally learn outside of school settings. This leads him to a central question driving much of his research. He asks, "Why is there no word in English for the art of learning?" (p. 82). For Papert, this gap in the lexicon highlights a failure in scholarly research and in the educational system itself.

Pedagogy — the word used for the study of teaching — emphasizes the teacher's role in the process of learning and places the student in a passive role in a manner that is reflected both in research and in formal education. Though Papert's proposed "mathetics" to mean the art of learning (1980) has not entered into general use in academia, his development of constructionism shifted the focus of educational research to *how* students learn rather than how or what they ought to be taught. And, as Wenger (1998) contends, "our perspectives on learning matter" because they shape where learning is recognized and how it is fostered (p. 9).

Constructionism builds upon the progressive pragmatism of Dewey as well as the constructivism of Piaget. The notion that education should be experiential is customarily attributed to John Dewey (Blikstein, 2013) who long ago called attention to

a desperate need for education that values "impulses to make, to do, to create, to produce, whether in the form of utility or of art" (Dewey, 2001, pp. 18-19). Like other progressive educators (Kilpatrick, 1918; Montessori, 1917), Dewey holds that the education of children must involve intimate experience with "nature at first hand" and the manipulation of "real things and materials" (Dewey, 2001, p. 8).

Piaget's doctrine of learning fits well within this experiential framework. Piaget contends that learners constantly construct and reconstruct their own knowledge through personally meaningful experiences with the world (Ackerman, 2016). It therefore cannot be transmitted directly from one person to another. Individuals build their own "cognitive tools, as well as … their external realities" (Ackerman, 2016, p. 7); they understand the world through invention (Piaget, 1973). Whereas cognitivist views of learning engender instructionist methods of teaching, Piaget's constructivist view of learning necessitates more learner-centric approaches. These are, of course, far from being new ideas. What is surprising, however, is how often they are discussed and how rarely they are enacted in today's schools.

The Essential External Artefact

To understand its connections to making, the most important aspect of Papert's constructionism is the way it expands upon Piaget's view of knowledge-building by explicitly focusing on the value of working with external representations of learning. This concept took root through Papert's own experience comparing levels of student engagement in art and math classes. He imagined the possibility of students creating

products in a junior math class in the same way that they are produced in art — with "time to think, to dream, to gaze, to get a new idea and try it and drop it or persist, time to talk, [and] to see other people's work" (Papert & Harel, 1991, n.p.). In answer, he developed the LOGO programming software (Papert, 1980) that enabled children to explore math concepts by writing code that controlled a turtle. The LOGO turtle stands as the initial example of what would become the essential external artefact of constructionism. An artefact "can be shown, discussed, probed, and admired" (Papert, 1993, p. 142) and it is this through which its creator represents, understands, and develops his or her own learning (Sheridan et al., 2014).

For Papert, building one's own knowledge "happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sand-castle on the beach or a theory of the universe" (Papert & Harel, 1991, n.p.). It is what distinguishes constructionism as a learning theory: knowledge is constructed through the activity of making an artefact to be shared with others (Halverson & Sheridan, 2014; Martinez & Stager, 2013). Enyedy (2005) refers to this ability to construct an external representation of a complex idea as a marker of intelligence across disciplines (Halverson, 2013; Litts, 2015) while deCastell (n.d.) argues that the production of things leads to the production of insights.

For Sheridan et al. (2014), an essential aspect of the artefact is that it is shareable with an audience — it is the audience after all that lends authenticity to the work and thereby makes the learning powerful. However, for many makers and researchers it is not the final product that truly matters; instead, it is the process through which the

artefact is created that matters most. This is an idea echoed by Gauntlett (2011) in his discussion of knitters and quilters for whom the outcomes are considered "relatively unimportant" (p. 69) in comparison to the sense of well-being and the pleasure in community derived from their construction. It is also the experiential process of making rather than the product itself that reveals the important ways this approach shapes learning.

Before moving on, it is worth noting here that scholars who root makerspace research in constructionism must often contend with conditions that prevent them from fully implementing Papert's original ideas. This seems especially true for those dealing with the systemic constraints of public schools where researchers "run up against a range of structural challenges" (Halverson & Sheridan, 2014, p. 500). Where a constructionist approach to learning would have topics and projects chosen and directed by students (Papert, 1993), for example, teachers must work within the constraints of a standardized curriculum.

Where constructionists would give students unstructured "time to think, to dream, to gaze…" (Papert & Harel, 1991, n.p.), the fully structured school day does not allow such freedom. Nor does the fragmentation of knowledge into subjects and those subjects into units. There is also the issue of socioeconomics that shapes access to materials and technology and the "digital divide" that calls into question any "generalized or universal concept of DIY citizenship" discussed in the makerspace literature (Ratto & Boler, 2014, p. 12). These are some of the "structures that guide and

sometimes limit students' work" (Jenson et al., 2014, p. 173) that must be part of any comprehensive understanding of school-based making.

The Makerspace Phenomenon

The drive to make — to bring something new into the world that did not previously exist — is arguably as old as humankind's first attempts at crafting tools or building shelters. For many in today's maker movement, including Mark Hatch, the former CEO of one of the first and largest makerspaces in North America, making is "fundamental to what it means to be human" (Hatch, 2014, p. 1). Likewise, Dale Dougherty (2012), founder of Make Magazine and creator of Maker Faire, suggests — perhaps naively — that we are all makers, no matter who we are or how we live.

In tracing its history, Gauntlett (2011) roots today's maker movement in the Arts and Crafts movement that began in Victorian Britain in the 1860s and spread globally between 1887 and the start of the first World War (Arts and crafts movement, n.p). The Arts and Crafts movement was inspired by the work of William Morris. Like John Ruskin before him, Morris reacted against what he saw as the dehumanizing impact of the industrial revolution (Arts and crafts movement, n.p.). Where Ruskin idealized the creativity and human imperfections evident in medieval craftsmanship and decried the repetitive machine-work of England's factories, Morris went on to envision the possibility of more meaningful, harmonious living through a revival of the traditional crafts and architecture of the medieval world (Gauntlett, 2011).

In his essay *The Lesser Arts*, Morris (1887) writes, "To give people pleasure in the things they must perforce use, that is one great office of decoration; to give people pleasure in the things they must perforce make, that is the other use of it" (as cited in Arts and crafts movement, n.p.). According to Gauntlett (2011), Americans added a democratizing aspect to the Arts and Crafts movement, encouraging people to make beautiful handmade objects themselves in what has come to be known as do-it-yourself (DIY) culture. In the 1960s and 1970s, this DIY culture took on a radical political element for a number of writers, including Ivan Illich who once stated that people "need above all the freedom to make things among which they can live" (as cited in Gauntlett, 2011, p. 172). Today's maker movement developed out of this DIY culture and still retains currents of its politicized thinking, more thoroughly explored in the literature on 'critical making' "in which productions … are understood as politically transformative activities" (Ratto & Boler, 2014, p. 1).

Without a clear definition or an official directory, it is difficult to pin down hard numbers of makerspaces worldwide. The issue is complicated somewhat by a muddying of terms. Though some participants differentiate amongst makerspaces, hackerspaces, and fabrication labs, in light of their emphasis and/or intended audience, the lines between these identifiers are blurred. In fact, the hackerspaces.org wiki collects all three types of spaces under the umbrella definition of "community-operated physical places, where people can meet and work on their projects". This helpful user-generated list currently contains nearly 1400 active makerspaces, hackerspaces, and fab labs in over 100 different countries worldwide, with yet another 355 spaces listed as in

the planning stages[3]. Notably, the highest concentration of these sites exists in North America and Western Europe.

What are these makerspaces, exactly? There is no set definition, but a number of scholars have weighed in on this question, calling attention to how makerspaces provide a place for participants to gather together to explore, invent, and create meaningful interdisciplinary projects using a range of low- to high- technological tools and supplies — everything from bolts and string to welding torches and 3D printers (Blikstein, 2013; Halverson & Sheridan, 2014; Sheridan et al., 2014).

The Institute of Museum and Library Services claims that makerspaces are "part of a growing movement of hands-on, mentor-led learning environments to make and remake the physical and digital worlds …. foster[ing] experimentation, invention, creation, exploration, and STEM learning" (as cited in Litts, 2015, p. 3). Litts (2015) refers to makerspaces as "sites of rich experimentation and innovation" (p. 49) that are "primarily made up of community, space, and tools" (p. 5). In *Learning in the Making: A comparative case study of three makerspaces,* Sheridan et al. (2014) refer to makerspaces as "informal sites for creative production in art, science, and engineering where people of all ages blend digital and physical technologies to explore ideas, learn technical skills, and create new products" (p. 505). Similarly, Peppler et al. (2016) view makerspaces as "embodiments of the self-reliant ethos of DIY culture" in which learning is "propelled through a maker's curiosity, trial and error, and resourcefulness" (n.p.). Collectively, makerspaces both reflect and continuously generate a growing global *maker movement* in

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[3] These numbers were accurate as of March 2020 according to hackerspaces.org.

which individual *makers* are "engaged in the creative production of artifacts" (Halverson & Sheridan, 2014, p. 496) using "a mix of digital fabrication, open hardware, software hacking, and traditional crafts to innovate for themselves, underpinned by an ethos of openness and skill sharing" (Taylor et al., 2016, p. 3). Though there is currently no single accepted definition of a makerspace, these scholarly descriptions point to the common elements of these spaces that connect them within a movement.

What is Makerspace Pedagogy?

In recent years, there has been a proliferation of school and community-based makerspaces that engender the type of student-centered, project-based, hands-on learning so enthusiastically embraced by many of today's education professionals. To teach through making — whether in a designated makerspace or in a classroom — means to immerse students in an authentic, deep learning task usually towards the production of a shareable artefact. It is to provide the materials, the tools, the space, and the time for students to engage in an active and exploratory process of designing and building, a process led by students and facilitated by the teacher. Often this process is described as "tinkering" (Resnick & Rosenbaum, 2013), a term that speaks to an iterative approach that involves students in a dialogue with whatever materials they are working. Tinkering "affords a deep conversation with the material" so unlike traditional schooling in which "learners are rushed ahead to find a solution to a predefined problem" (Sheridan & Konopasky, 2016, n.p.).

Such experiential learning has been discussed by educational theorists for over a hundred years, since a time when Dewey pointed out that the "great waste in school" is the disconnection between daily life and formal learning (Dewey, 2001, p.46). However, what Dewey might find in the makerspace is an environment utterly devoted to learning through experience, one that connects students meaningfully to the products of their own labour and thinking. These are spaces in which participants avail themselves of the tools (or affordances) provided in order to build their own knowledge as they invent, create, and construct their own products (Hannafin et al., 1997). In keeping with its Arts and Crafts heritage, the makerspace works against the ways in which today's schools too closely resemble their industrialized past.

Rooted in constructivism, the constructionist theorists' view of learning engenders approaches to teaching that are learner-centric rather than teacher-driven. In particular, constructionists contend that students learn particularly well by building external representations of their own knowledge to be shared with others. Making is therefore an ideal example of this constructionist approach, one that is well aligned with the espoused aims of 21st century learning. That is, making is perfectly suited to the critical shift educators are attempting in moving from knowledge consumption to knowledge creation as the central goal of Western education in the new millennium (Ananiadou & Claro, 2009; Dede, 2010; Ontario Ministry of Education, 2013; Voogt et al., 2001). Bal et al. (2014) argue: "As educators, researchers, and co-learners in the maker culture, it is our task to help children prepare themselves for the future, nurturing their own autonomous learning capacity often disregarded in standardized

education" (p. 159). Finally, Papert (1993) argues, "the best learning takes place when the learner takes charge" (p. 25), and makerspace pedagogy does just that: it puts students in charge of making both their own projects and, consequently, their own knowledge.

Chapter Three: Theoretical Framework

A Constructionist View of Making and Mindfulness

Halverson and Sheridan (2014) suggest that the literature on makerspaces can be helpfully divided into three components based on related activities, participants, and spaces. In the previous chapter, I introduced this literature by providing a historical account of making, a description of common practices in makerspaces, and an explanation of makerspace pedagogy. To accurately communicate these common practices and the related pedagogy, I began with an explanation of constructionism that included a discussion of its centrepiece: the essential external artefact. In this chapter, I build upon that foundational understanding by using a constructionist lens to consider the three components of making, makers, and makerspaces. I then apply this same constructionist framework to the literature on mindfulness in order to identify and discuss relevant connections between the pedagogies.

Making: Learning through Experience

Making Mistakes

Making involves an experiential approach to learning — trying, failing, redesigning, and trying again — in which a maker must overcome any number of unforeseen obstacles along the journey to a final product. This design process involves what constructionist scholars might refer to as a reflective practice through which learners make sense of the world. As "powerful pattern recognizers" humans "probe,

hypothesize, reprobe, [and] rethink", evaluating each hypothesis based on a set of "goals, desires, feelings, and values" (Gee, 2003, pp. 91-97). This is a process that requires and teaches problem-solving skills and persistence, one in which mistakes are expected. Mistakes require a maker to redesign and try again; they are productive "learning opportunities" (Kafai & Fields, 2018, p. 5) and they help to make the learning transparent. In working with e-textiles, for example, Kafai et al. (2012) claim that students were able to identify and fix mistakes throughout a "recursive" construction process (p. 190) rather than waiting until the project was complete. In a similar study, Kafai and Peppler (2014) argue for the educational value of transparency when working with technology — that understanding how things work is beneficial for students. They go on to suggest further that making with e-textiles renders "simple misconceptions … apparent" during construction by "providing opportunities for concretizing knowledge" (pp. 181-185). That is, gaps in understanding are made conspicuous through any non-working part of an artefact throughout the process of its construction. This transparency is a fundamental part of why constructionism insists upon an external representation of thinking.

Making Mental Tools

Externally representing one's learning involves a deep understanding of the tools at one's disposal. In making, these can of course be physical tools, but they might also be viewed as the mental tools of constructing learning. To illustrate this concept, Papert (1993) turns to the image of Levi-Strauss' (1966) *bricoleur*, the bygone travelling tinker

who carried with him assorted tools from which he would choose the best for each job. As a metaphor for an intellectual approach to problem-solving, the tools of the *bricoleur* are honed and valued for "pragmatic utility", each one potentially effective in solving a multitude of problems through improvisation and "mak[ing] do" (Papert, 1993, p. 144). In this metaphor, Papert emphasizes understanding one's own learning: "[C]hildren will do best by finding … for themselves the specific knowledge they need" (Papert, 1993, p. 139).

Developing and continuously refining a set of one's own mental tools, understanding their utility, and using them appropriately for the work at hand are all central to a constructionist view of making (Ackerman, 2016). Some scholars refer to this set of skills as meta-representational competence (MRC) (diSessa, 2004; Halverson & Sheridan, 2014, Reisberg, 1987; Sheridan et al., 2014). In the context of arts education, for example, Halverson & Sheridan (2014) refer to MRC as an ability to understand when and why one might make use of certain tools to communicate a particular idea. And in the context of science education, diSessa (2004) adds the importance of being able to evaluate how well an external representation reflects abstract concepts.

Making Knowledge

Often referred to as 'objects to think with' (Halverson, 2013; Litts, 2015), external representations aid learning by rendering thoughts tangible and by fostering relationships between the maker and the knowledge used to make. In fact, Kafai et al. (2012) attribute mental connections to the literal threading together of various

representations in e-textiles. Likewise, Kafai and Peppler (2014) note that "…the fabrication of stitches, circuits, and codes reveals the underlying structures in tangible and observable ways" (p. 181). Papert (1993) also recognizes the importance of "knowledge in use" that one can push around to "fix minor bugs" (p. 63). Seen this way, objects are externalized versions of internal representations of knowledge and their physicality plays an important role in stimulating new understandings (Halverson, 2013). This notion calls to mind Wenger's (1998) use of the term "reification" for "the process of giving form to our experience by producing objects that congeal this experience into 'thingness'" (p. 58). Though Wenger's objects might be words rather than physical artefacts, he discusses them in terms familiar to constructionists, as "points of focus around which the negotiation of meaning becomes organized" (Wenger, 1998, p. 58).

Indeed, Sheridan et al. (2014) hold that physical objects enable the maker to form a relationship with knowledge, one that encourages an ongoing conversation between the external representation and the maker's interpretation of that representation (Ackerman, 2016; Litts, 2015). Each iteration of an artefact stimulates new knowledge that shapes the next iteration. This process, this conversation, never objectively ends; instead, it is usually brought to a close only by virtue of a maker's sense of achievement. The constructionist view holds that this is an enriching process —a deep learning experience — that is arguably more valuable to a maker than anything he or she produces.

From a constructionist perspective, then, making can be viewed as an experiential learning process that involves iteratively building and rebuilding an external representation of one's own knowledge, making mistakes and reflecting upon one's own thinking, understanding the mental tools available, and persisting through difficulties and obstacles. But how does this experiential process impact the learners? In this next section, I turn to the participants to explore how making activities are thought to shape the makers themselves.

Makers: Learning Empowerment

In becoming producers of their own knowledge and their own artefacts, makers gain an empowering sense that they can participate fully in the shaping, making, and transforming of their own worlds. No longer merely consumers — of objects, technology, media, education, or knowledge itself — makers take on the identity of a producer with the power to create change in the world (Ratto & Boler, 2014). This — the possibility of forming and reforming one's own identity — is in an empowering notion (Papert, 1993). Too often, young people are limited in their intellectual growth by labels applied through formal schooling; when a child learns that he or she 'can't do math', for example, that label becomes self-reinforcing.

Raising Makers' Voices

The open, explorative nature of a constructionist learning environment, on the other hand, supports young people in taking risks and trying on new versions of

themselves. For example, resourcefulness is part of the makerspace ethos and it is essential for surmounting the numerous unforeseen obstacles that arise in the course of making any artefact. Resourcefulness allows makers to see the potential in themselves (Papert, 1993) and in the world around them (Sheridan & Konopasky, 2016). Similarly, the community aspect of a makerspace helps to create an encouraging atmosphere in which individual voices are heard and valued (Taylor et al., 2016).

In their work with students developing anti-bullying artefacts, Hughes et al. (2016) chose the makerspace specifically for its ability to encourage the expression of voices. Maker education gives "voice to children and learners" and teaches them to "participate in acts of self-determination and … various forms of production" (Bal et al., 2014, p. 162). Likewise, Wenger (1998) notes that people produce identities by "encounter[ing their] effects on the world and develop[ing their] relations with others" (p. 151). Understanding oneself as a producer amongst a community of producers — of both knowledge and artefacts — leads to a sense of ownership of the intellectual means of that production. That is, the maker is in charge of his or her own learning. This is a key aspect of the constructionist view of making and it has important implications for education.

Putting Makers in Charge

Traditional education has long been criticized for impoverishing relations between students and their own learning. In the early 19th century, Joseph Jacotot discussed educational methods "that made the teacher's knowledge and know-how the

objective to be ultimately reproduced" and made "student incapacity" the "educative starting point" (Thumlert, 2015, p. 116). The message for students is that "one cannot act, imagine, think, or do without guidance, [including] predicted environments, calculated sequences, and developmental scaffolding" (Thumlert, 2015, p. 116).

For Ranciere (1991), "explication is the myth of pedagogy" (p.6) based upon ignorance of the "true power of the human mind" (p. 15). Illich (2000) sounds a similar alarm about traditional schooling. He writes, "In school we are taught that valuable learning is the result of attendance; that the value of learning increases with the amount of input; and, finally that this value can be measured and documented by grades and certificates" (p. 24). For Illich, learning is the most natural of human activities, and the one least in need of being shaped and managed by others. "Most learning," he writes, "is not the result of instruction. It is rather the result of unhampered participation in a meaningful setting" (p. 24).

Papert (1993) echoes this idea when he claims that he already knew in elementary school that his best intellectual work was done "outside the classroom" (p. 23). Similarly, Freire (2000) argues vehemently that students need to form a critical consciousness of their own ability to shape and transform the world around them. They must understand "what an intelligence can do when it considers itself equal to any other" (Ranciere, 1991, p. 39).

This ability does not come from students taking a passive role in their own education; rather it comes from what Freire calls a "problem-posing education" and an understanding that "knowledge emerges only through invention and re-invention,

[and] through the … hopeful inquiry human beings pursue in the world, with the world, and with each other" (Freire, 2000, p. 72). Papert (1993) tells us that the best learning happens when the learner is in charge. Through the constructionist activity of making, learners do indeed take charge, seeing in themselves all the potential they have to be makers and shapers of the world.

Valuing Makers' Work

The structure of the formal education system perfectly reflects the hierarchical view of knowledge upon which it is based (Papert, 1993). Makerspace pedagogy seeks to undermine this hierarchy by rethinking traditional views of knowledge and by making both physical and intellectual space for new ways of thinking. Perceiving knowledge as transmittable facts, and ways of knowing as separable into lower and higher orders, lends itself neatly to what Papert (1993) calls "the traditional paraphernalia of curriculum, hierarchy, and control" (p. 65). A constructionist view of learning, on the other hand, expands what counts in school, and "legitimate[s] a broader range of identities, practices, and environments" (Halverson & Sheridan, 2014, p. 503).

Putting "powerful construction materials in the hands of children" (Blikstein, 2013, p. 5), also works to revalue makers' concrete ways of thinking. The educational system has traditionally viewed concrete intelligence as a developmental stage on the road to abstract reasoning, but constructionism elevates it as valuable in its own right (Papert, 1993). In fact, deCastell (n.d.) tells us that education has long prized 'brain

work' over 'body work' with the mental/manual hierarchy most apparent in the system's treatment of academic versus vocational paths (n.p.). Schools provide spaces for the work they value (Blikstein, 2013), so the loss of classrooms dedicated to concrete learning (like shop and home economics) is telling.

The separation of intellectual from physical work was already being denounced in the mid 1800s by John Ruskin in response to England's industrialization (Gauntlett, 2011). In *The Nature of Gothic,* Ruskin (1853) admires the integration of intellectual with physical labour evident in the beauty and imperfections of medieval craftsmanship. He decries its loss through mechanization and piece work just as his contemporary Karl Marx did in arguing against the alienation of the worker from the product of his work (Gauntlett, 2011). In contrast, through "cheap hardware, easy access to digital fabrication, and shared software and designs" (Halverson & Sheridan, 2014, p. 497) makers own (or at least easily access) the means of physical production. Making also works to "democratize access to the discourses of power that accompany becoming a producer of artifacts" (Halverson & Sheridan, 2014, p. 500) and to reunite physical and intellectual labour (Gauntlett, 2011; Kafai & Peppler, 2014). Perhaps most hopeful of all, the recent proliferation of makerspaces in classrooms and school libraries has the potential to serve — and therefore empower — a greater diversity of student-makers and their ways of learning and knowing.

By (re)integrating intellectual and manual labour, by valuing students' voices and work, by teaching students to be producers (of knowledge and things), and by putting students in charge of their own learning, making empowers students by

rejecting and/or reshaping long-held educational practices that undermine their

agency. Now, I turn to the makerspaces themselves to explore their role in shaping

makers and how they learn.

Makerspaces: Learning Socially

Though the sizes, configurations, and locations of makerspaces vary widely, and

the tools they contain vary according to both needs and means, they are all spaces

containing tools that, above all else, provide their participants with a community in

which to make, a community in which collaboration and knowledge-sharing are held as

core components (Sheridan et al., 2014; Taylor et al., 2016). Above all else, makerspaces

are social. This is where do-it-yourselfers eschew isolation to enjoy the social benefits

and leverage the knowledge and skills of doing-it-together.

For many participants, these spaces offer up what Oldenburg (1989) refers to as a

"third place" that is neither home nor work, where makers gather regularly and

informally to derive much-needed mental and emotional health benefits (Litts, 2015;

Oldenburg, 1989). Though there are some important concerns about diversity that need

to be addressed[4], they are generally considered to be *open* social spaces, and in more

than one sense. First, they are open in terms of welcoming newcomers. For a culture

that deeply values connecting people (Sheridan et al., 2014), this is only fitting. In fact,

makerspaces often provide social spaces for excluded groups (Taylor et al., 2016) and

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[4] Though beyond the scope of this dissertation, the issue of diversity in making is an important one. Please see Buechley, 2013; Grenzfurthner & Schneider, n.d.; Halverson & Sheridan, 2014; Kafai & Peppler, 2014; Margolis and Fisher, 2003.

they promote an atmosphere in which experienced makers provide newcomers with mentorship (Halverson & Sheridan, 2014; Peppler et al., 2016). Second, makerspaces are open in the sense that they foster and encourage the sharing of knowledge. As a central part of the maker movement (Taylor et al., 2016), openness manifests in the way that tools, materials, and skills are shared, the way that expertise is distributed amongst participants, in the free provision and use of feedback, and in the deliberate use of open source software. This latter characteristic speaks to maker-culture's alignment with principles associated with "the open source way" such as open exchange, collaborative participation, and transparency ("What is open source?", n.d.). Indeed, researchers note that open collaboration is the essence of a makerspace; it is what makes them work (Kafai & Harel, 1991; Litts, 2015).

These spaces can be viewed as communities of practice (Lave & Wenger, 1991) in which individuals connected by a common domain choose to work and learn together (Sheridan et al., 2014). Like all communities of practice, the makerspace is "a locus of engagement in action, interpersonal relations, shared knowledge, and negotiation of enterprises" that can lead to "real transformation" in people's lives (Wenger, 1998, p. 85).

When newcomers are welcomed to the space, they can be viewed as legitimate peripheral participants (Lave & Wenger, 1991) who, over time and through multiple and varied experiences of negotiating and renegotiating meanings, become full participants within the community (Halverson & Sheridan, 2014; Lave & Wenger, 1991; Wenger, 1998). And there is a freedom to this movement that is central to the

makerspace approach, one that capitalizes on the distributed expertise in the space but does not govern its use (Halverson & Sheridan, 2014). That is, as a constructionist learning environment, the makerspace refuses a fixed curriculum and instead is designed to be a convivial space in which each learner works either with or alongside others to bring a project into the world (Blikstein, 2013).

Sharing Knowledge

This is perhaps the most obvious point about the social nature of makerspaces: knowledge within them is shared. After all, human learning "presupposes a specific social nature" (Vygotsky, 1978, p. 88). Individuals make sense of the world around them through social interaction, especially through language (Ackerman, 2016, Litts, 2015). For Vygotsky, this sense-making happens through zones of proximal development, "a process by which children grow into the intellectual life of those around them" (p. 88). Brown and Campione (1994) describe these zones as "the distance between [an individual's] current levels of comprehension and levels that can be accomplished in collaboration with people or powerful artifacts" (p. 236).

The compulsion to share knowledge is therefore "a central design feature" of makerspaces, based on the understanding that "skills, knowledge, and ideas build up more quickly when everyone contributes" (Sheridan & Konopasky, 2016, p. 31). Makers form communities of practice where they build and share complex ideas and understandings (Wenger, 1998; Sheridan & Konopasky, 2016). Some of this knowledge is shared via solicited and unsolicited feedback (Sheridan et al., 2014) that allows participants to learn from the mistakes and successes of others. And it is distributed as

people, texts, tools, and technologies — those cultural devices central to Vygotsky's

thinking — that are all leveraged as sources of stored knowledge. What matters in these

spaces is the quality of the network, or the efficiency with which information travels

between its sources. These are also common features of communities of practice

(Sheridan et al., 2014; Wenger, 1998).

One might join a local makerspace, then, in order to contribute to and leverage

the many intellectual and social benefits of belonging to a community. Whether in a

community centre or in a school setting, the makerspace ethos works to connect

participants, encouraging them to share space, tools, materials, skills, and knowledge.

Connections to Mindfulness

Having explored, from a constructionist perspective, the activities, the

participants, and the spaces in makerspace literature, I now turn my attention to similar

components in the literature on mindfulness. Numerous studies describe the (obvious)

suitability of constructionist principles in teaching various technological subjects

(Buechley et al., 2013; Kafai et al., 2009; Kafai et al., 2014; Martinez & Stager, 2013). As

mentioned previously, however, there are no studies that apply these same principles to

teaching mindfulness. This should not suggest a lack of suitability. Researchers Schon et

al. (2014) claim that "compared with other approaches for learning with technologies …

[making] can be used for a diverse set of disciplines [and] learning settings (p. 9). For

example, Hughes et al. (2016) used constructionist/makerspace pedagogy in a program

aimed at bullying prevention amongst grade six students. Though rare, examples such

as this one hint at educational possibilities for constructionism/making in teaching non-technological subjects. Based on his multi-year study of MIT's Constructionist Learning Laboratory, Stager (2005) concludes that "constructionism as a foundation for designing productive learning environments" is viable for "the broader learning community" (p. 1) which, I would argue, includes those students learning abstract, non-technological subjects like mindfulness. My purpose in this next section, then, is to highlight the constructionist links between mindfulness and makerspace literatures that were helpful in designing an integrated curriculum.

Being Mindful: Learning through Experience

Many mindfulness scholars take a view much like that of constructionists towards making. That is, the *process* of being mindful is far more important than any product. Mindfulness is an ongoing practice of paying attention to the present moment (Brown & Richard, 2003; Grossman et al., 2004; Kabat-Zinn, 2003). While benefits (or products) arise from this practice, traditional mindfulness practitioners focus on the ever-deepening practice itself. And, like making, mindfulness is inherently experiential. It is something that improves and deepens with practice. Like reading or swimming, understanding comes from the doing of it, much more so than learning about it. "Participants are urged to practice on a daily basis," claim Gouda et al. (2016), "to allow the concept [of mindfulness] —which is a thoroughly experiential one—to come to full fruition" (n.p.). While Kabat-Zinn (2013) writes, "it isn't really about *doing* at all, or

about getting somewhere else. It is much more about *being* — about allowing yourself to be as you already are" (p. xxix).

That said, *being* requires effort; it requires "actively tuning in to each moment in an effort to remain … aware from one moment to the next"; it is a practice of "non-doing" that is "rich and complex" (Kabat-Zinn, 2013, p. 6). The difference between learning *about* being and *experiencing* that sense of being is profound. People cannot learn to swim without immersing themselves in water; likewise, they cannot learn mindfulness without immersing themselves in a personal meditative practice (Burke, 2009; Paneduro, 2016; Segal et al., 2004).

Just as in making, practising mindfulness involves repeatedly experiencing failures, or rather what appear to be failures — of concentration, of focus, of an ability to let go of worries. Yet these 'failures' are simply characteristic of how minds function, and of the seemingly boundless neural connections of which human brains are capable. Experiencing and accepting this is an essential aspect of the journey toward greater mindfulness, as is the ability to see each 'failure' as an opportunity for further practice (Kabat-Zinn, 2013, Shapiro et al., 2006). In making, mistakes are "learning opportunities" (Kafai & Fields, 2018, p. 5); in mindfulness, Shapiro et al. (2006) speak of a wandering mind as an opportunity to practise one's "ability to shift the focus of attention … at will" (p. 376). In keeping with constructionist principles, both making and mindfulness are experiential learning processes in which the process itself is of central importance. And, as with making, this mindfulness process shapes the learner.

Mindfulness Practitioners: Learning Empowerment

Mindfulness practitioners are encouraged to accept the way things are. They are taught to embrace each moment as it comes and to bring a non-judgemental awareness to thoughts and feelings that arise. This is quite unlike makers who — as previously discussed — are taught to take a more active stance towards the world. Whereas makers are trained in the role of producers and/or shapers of knowledge and things, mindfulness practitioners are trained in a stance of acceptance towards the world. Both roles are empowering, however. The mindful practitioner's non-judgemental awareness of the world — what Kabat-Zinn (2013) calls a "complementary form of intelligence" (p. xxxv) — is empowering in three key ways. First, mindfulness teaches that we are not our thoughts. It enables the practitioner to "experience thoughts as … events in the mind, rather than as direct readouts on reality" (Teasdale, 1999, p. 147). This means not believing in or even engaging every (negative) thought that arises and choosing to dismiss those thoughts perceived as unhelpful. There is power in this choice.

Second, mindfulness teaches that thoughts and feelings are transient. It encourages what Deikman (1982) refers to as "the observing self" and what Bishop et al. (2004) call a "decentered perspective". This is a metacognitive ability that "observe[s] internal and external experiences without distortion from affective, cognitive, or physiological reactivities" (Semple et al., 2010, p. 220). Witnessing one's own mind while knowing that thoughts and emotions dissipate without engagement provides the mindfulness practitioner with a degree of power over emotions and a sense of some control in life.

Third, practising mindfulness creates a space in which one's responses to the world can be consciously formed. Though events may at times be beyond one's control, reactions to those events are not. The mindfulness practitioner is able to shape responses to internal and external situations (Arch & Craske, 2006; Robins et al., 2012; Roemer et al., 2015; Sedlmeir et al., 2012; Tang et al., 2016). This ability "provide[s] us with the freedom to choose the way we respond to whatever comes our way, and that is incredibly powerful and liberating" (Soloway et al., 2010, p. 226). Indeed, as pedagogies, making and mindfulness empower students in very different yet complementary ways. Just as makers learn to be shapers of the world around them, mindfulness practitioners learn to be shapers of their own reactions to the world. An essential aspect of shaping one's reactions is maintaining a sense of openness to all that life offers.

Mindfulness: Learning Socially

Central to the social nature of makerspaces is the openness of maker culture that encourages sharing ideas, knowledge, space, and tools. There is a similar openness to the practice of mindfulness. Just as many makers are open and curious about learning from others, about new ideas, and about how things work, many mindfulness practitioners tend to be open and curious about life, or what Kabat-Zinn (2013) refers to as "the great adventure of … life unfolding moment by moment" (p. xxviii) and "the full catastrophe" of living (p. xxvi). Mindfulness can encourage an attitude of acceptance towards life's experiences, and an openness to each moment as it comes

(Corcoran et al., 2010; Kabat-Zinn, 2013; Meiklejohn et al., 2012; Roemer & Orsillo, 2002; Shapiro et al., 2006).

Practising this orientation over time is likely to "increase dispositional openness, a trait … characterized by curiosity and receptivity to new experiences" (Bishop et al., 2004, p. 12). This stance of open acceptance to life's experiences necessarily includes openness to experiences with other people. Indeed, the practices involved in mindfulness training often "focus on cultivation of prosocial attitudes and behavior, such as compassion, empathy, and respect for others" (Shapiro et al., 2014, p. 2-3), and a number of studies have linked mindfulness training with increases in empathy and compassion (Davidson et al., 2003; Shapiro et al., 2007; Shapiro et al., 1998).

Perspective taking, the third axiom of Shapiro et al.'s (2006) model of mindfulness, speaks to such prosocial outcomes. Perspective taking refers to a "variety of metacognitive skills" that include "discerning the thoughts and feelings of others" and "flexible shifting between one's own and others' perspectives" (Shapiro et al., 2014, pp. 22-23). It is perhaps, in part, because of the link between mindfulness training and important social skills like "care and concern for others" that educators are increasingly likely to use mindfulness to "enhance classroom climate" (Jennings et al., 2011, p. 373).

Conclusion

Though makerspaces are a fairly recent phenomenon and a relatively new focus of study, the related literature already offers a detailed understanding of what these spaces are — in all their forms — and the many ways they leverage a constructionist

approach to learning. In this chapter, I have explored that understanding by viewing making, makers, and makerspaces through a constructionist lens. I have also drawn parallels to comparable components of mindfulness to highlight certain similarities in these disparate literatures. These parallels were helpful in designing the integrated curriculum (see Appendix A). In this next chapter, I turn my attention to designing that curriculum and, first, to a full description of the research methodology used in its study.

Chapter Four: Methodology

An Ethnographically Informed Approach to Studying a Constructionist Curriculum

In this research, I explore how mindfulness and makerspace pedagogies interact when carried out in the single curricular intervention (see Appendix A) that lies at the heart of this dissertation. 'MakerMinds' was developed to blend together generally accepted principles of makerspace pedagogy (Blikstein, 2013; Halverson & Sheridan, 2014; Sheridan et al., 2014) with what might be considered the 'classical' content of any mindfulness training program, including mindful experiences, mindful movement, and various meditative practices (Flook et al., 2010). My purpose in creating this program was first and foremost to address an issue raised in the mindfulness research indicating that young people often have trouble fully engaging in traditional mindfulness training programs aimed at promoting their mental well-being (Britton et al., 2014; Maloney et al., 2016; Milligan et al., 2013). In response, I sought to combine the elements of a typical mindfulness program with a constructionist pedagogical approach arguably well-suited to the educational needs and interests of children. As an integrated curriculum of this kind had never before been attempted, my research was entirely exploratory.

In April and May of 2019, I implemented MakerMinds as an eight-session weekly program with a group of 26 grade four students — 24 of whom agreed to participate in the study itself. The program took place at the Albert Classum[5] Elementary School in a suburban neighbourhood outside of Toronto, Ontario.

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[5] All names have been changed, including that of the school, the teacher, and the students.

Managing a class of this size would have been very challenging if I had to conduct the program alone; I was therefore fortunate to have the help of a naturopathic doctor/certified yoga instructor who acted as a co-facilitator and research assistant. In addition, the classroom teacher was present for each of the sessions. Aside from occasionally participating in meditations and mindful movement exercises, and observing students while they were making, the teacher stayed mainly in the background throughout the study.

Ethnographically Informed Research

The aim of this ethnographically informed study was to explore *how* makerspace pedagogy and mindfulness training interact when carried out in combination, including how this combination impacts student-engagement in mindfulness training as well as their uptake of mindfulness content.

My approach was entirely qualitative in nature. More specifically, it adhered to the principles and practices of an ethnographer in an action research setting. Throughout the eight-week program, I was both researcher and facilitator of my own curricular intervention. My role as an observer of the intervention in action as well as a participant in it is consistent with Creswell and Poth's (2017) description of an ethnographic study as involving "extended observations of [a] group, most often through participant observation" (p. 68). Ethnography is rooted in "first-hand experience of the research setting" (Atkinson et al., 2001, p. 43) usually with a limited focus, perfect for in-depth and small-scale studies (Hammersley & Atkinson, 2007). It is

also "committed to interpreting the point of view of those under study" (Atkinson et al., 2001, p. 43) and it "portrays events, at least in part, from the points of view of the actors involved in the events" (Erickson, 1984, p. 52).

As both a methodology and a product, ethnography pushes the voices of its participants into the foreground even when (or especially when, in the case of critical ethnography) those voices are regularly silenced. In a school-based ethnographically informed study such as this one the voices that arguably most need to be heard are those of the students themselves. And ethnography "permits a view of children as competent interpreters of the social world" (James, 2001, p. 246) whose voices matter.

Finally, ethnography engages researchers in the "fine shadings of local meanings" (Erickson, 1984, p. 153). This approach allows for nuance and theoretically informed understandings of complex meanings. For this reason, and all the reasons listed above, following ethnographic conventions helped me to shape a research protocol that best fit my study and one that would be useful in producing what I hope is a compelling narrative.

Data Collection

In doing any ethnographic work the researcher is immersed into a particular culture, "watching what happens, listening to what is said, asking questions" and gathering copious field notes. However, there is also a freedom to collect "whatever data are available to throw light on the issues", drawing from a "wide range of sources of information" (Hammersley & Atkinson, 2007, p. 2). The qualitative data collection for

this study was therefore multi-method. The research protocol involved: observational

data from three different sources including my field notes, the field notes of my co-

facilitator, and field notes from a non-participant observer[6] whom I hired when the

school board turned down my application to video-record the sessions in progress,

citing privacy concerns. In addition, my original research protocol included student

reflection journals, photo documentation of the students at work and their artefacts in

process, a series of teacher interviews, a parental focus group, and interviews with

students. Since 'whatever throws light on the issues' is not always clear from the outset,

ethnography allows for changes to the research protocol as it unfolds and potential

sources of data can be "generated out of the process of data analysis" (Hammersley &

Atkinson, 2007, p. 3). In practice this meant that although I planned for a post-program

parental focus group, when parents voiced their preference for personal telephone

interviews, I was able to incorporate this method into my research protocol instead. In

addition, I was able to refine my original set of post-program student interview

questions based on preliminary data analysis (see Appendix B). In the following

sections, I provide detailed descriptions of each of the data collection methods used in

this study.

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[6] Throughout this document, my own field notes are cited as JEK's Field Notes. My co-facilitator's are cited as CF's Field Notes. Finally, the non-participant observer's notes are cited as NPO's Field Notes.

Observational Data

In keeping with Erickson (1984), observational data were collected throughout the program with only conceptual issues of interest identified ahead of time rather than any specific categories of observation. Differences in 'making' versus 'non-making' days and the breakdown of each session into repeated activities provided a loose conceptual framework within which to begin recording observations.

In addition to recording photographic documentation of the artefacts as they were being produced, my co-facilitator and I both took extensive field notes. We jotted down short-hand notes throughout each session and then sat down immediately after the session to flesh the notes out into much fuller descriptions of what we had observed. We regularly began this process together in the Learning Commons in the quiet after-school hours, but we always finished it up in our respective homes before the end of the day, often taking four to five hours to complete the field notes for one session. Because so much of our attention during each session was taken up with facilitating the program — and, as mentioned above, because the school board rejected both audio and video recordings of the students at work — I also hired a non-participant observer to gather comprehensive field notes of each session.

This allowed for triangulation of observational data via multiple sources, which is associated with improved validity in qualitative research (Mertens, 2010). The observer used a notebook and pen while moving about the room and a laptop while seated. She took short-hand notes throughout the session, expanded upon them in the

evening, and emailed them to me by the following day. She was present for every session, including the open house.

Reflection Journals

The student reflection journals were preformatted with four simple questions, including: *What thing(s) did you like about today?; What thing(s) did you <u>not</u> like about today?; Tell me something you learned about yourself; and, Tell me about any time(s) that you used a mindfulness tool this past week.* This set of questions was repeated seven times, once for each of the seven regular sessions of the program (leaving out the final open house), and students were given the time to write their answers in the last 10 minutes of each class. The journals were handed in to me at the end of every session to prevent students from losing them and to ensure that they remained private from one another. Once per week I scanned the journal entries into pdf format and then transcribed them into Word documents for ease of use at the analysis stage. At the end of the program I returned all of the completed journals to the classroom teacher for grading. As per the agreement reached in our first meeting, the teacher assessed the students' journalling efforts (rather than the content of their answers) as part of the literacy component in their regular school curriculum. Students were informed of this assessment when the journals were first introduced and then reminded of it again several times throughout the program. Each time this assessment was mentioned, I was also careful to point out that there were no right or wrong answers to any of the prompts. Once graded, the journals were returned to the students to take home. Although I had attempted to keep

the journals private from other students, it's worth noting that they regularly shared the contents with their peers during reflection time. Indeed, the facilitators often reminded students to sit apart from one another and work alone. Though the journals were returned permanently to the students at the end of the program, it is unclear whether or not they chose to share them with their parents or guardians. Students' weekly completion of these journals helped me to capture comparative data between the 'making' and the 'non-making' sessions. Most importantly, given that "relatively little is known about children and adolescents' subjective experiences with mindfulness training, particularly in school settings" (Maloney et al., 2016, p. 321), the journals served an essential role in facilitating the inclusion of student-participant voices (Himmelstein et al., 2012), an important aspect of ethnographically informed research.

Photo Documentation

Because the students' artefacts were so central to the MakerMinds program and to this study, documenting their creation over a period of eight sessions was essential. Throughout the program, the classroom teacher and I took photographs of the students at work on their models. All told, I gathered 141 date-stamped pictures that collectively capture the evolution of each group's final product and many of the different approaches used in representing their ideas. These photographs served as important reminders during analysis, at times supplementing field notes and providing a fuller sense of the making aspects of the program in particular. In the form of a slide show during the open house, the photographs also served as "an effective visual presence"

with "referential value" that helped visitors connect to the making process of participants and spark related conversations with students (Schecter & Otoide, 2010, p. 45). However, in this particular study, the usefulness of photography as a source of data was limited by the number of students who declined photographic evidence (three), the presence of two students not included in the study who could not be photographed at all, and the school board's insistence that photographs only capture non-identifying features. This made it nearly impossible to visually document any of the full-class activities that took place outside of the making itself. It also made it exceedingly difficult to capture any interactions amongst group members. And, finally, the existing collection of photographs reveals no mistakes, failures, or negative experiences in the making activity. Rather than being an accurate depiction of reality, this is a result of how preoccupied I was in those challenging moments with facilitating the making rather than taking out my camera to record the event.

Interviews

Over the course of the study, I conducted interviews with the classroom teacher, two parents who volunteered their input during the open house, and 19 of the 24 student-participants. With the classroom teacher, I conducted semi-structured interviews once per week, six days after the completion of each session. My intention was to leave enough time between a session and its follow-up interview for the teacher to observe any related behavioural changes in the student-participants and, potentially, to get a sense of their attitudes towards the upcoming session. By mutual agreement, all

of the interviews took place by phone immediately after school hours on a Wednesday, six days after our Thursday afternoon MakerMinds sessions. Each interview included the same set of questions: *Have you noted any positive student reactions to the program during the past week?; Have you noted any negative student reactions to the program during the past week?; Have you noted any student use of mindfulness techniques during the past week?;* and, *Is there anything else you would like to share with me about the program?* This repetition helped me to capture comparative data between the 'making' and 'non-making' sessions. As semi-structured interviews, however, there was room for me to pursue follow-up questions based on the teacher's responses (Mertens, 2010). I audio-recorded all of these conversations and then transcribed them within a day for ease of use during analysis.

Immediately following the eighth and final open house session of the program, parents were invited to participate in a voluntary focus group. Unfortunately, there were no volunteers, perhaps in part because the request took place at the end of the school day on a Friday. Instead, the parents of two student-participants offered their contact details so that I could reach them for a personal interview. I followed up with these parents within a week of the program's completion and asked them the questions that had originally been designed for the focus group. These included: *Has your child talked about the program at home?; Have you noticed your child using any mindfulness techniques at home?; Have you noticed any changes in how your child deals with stressful situations?;* and, *Is there anything else you would like to share with me about the program?* The purpose of these questions was to capture a sense of the overall efficacy of the

MakerMinds program and to gauge if students were making use of what they had

learned outside of the classroom. As with the teacher interviews, I audio-recorded and

then transcribed each phone call.

I also conducted individual semi-structured interviews with those students who

had agreed to participate in this activity. Fortunately, 19 of the 24 students agreed to be

interviewed and only two of these students declined the audio-recording. The student

interviews took place on two separate afternoons in the week following the program's

completion. In order to fit them into the time provided by the teacher without cutting

any of them short, I randomly divided the participants into two groups, one to be

interviewed by me and the other to be interviewed by my co-facilitator/research

assistant. The classroom teacher arranged two appropriate settings for the interviews:

one took place in a private room within the school's administrative offices, the other in

a private room within the Learning Commons. Both of these settings ensured the

students' privacy while also maintaining their sense of security as they were always

within easy reach of a number of teachers and administrators. The questions for these

interviews were based upon those I had planned prior to the start of the program, and

then further constructed following a preliminary analysis of the available data at the

end of the program. This emergent design is a common characteristic of qualitative

research and it allowed me to shape the interview questions appropriately (Creswell &

Creswell, 2017). In the end, we worked from a list of eight potential questions (see

Appendix B), allowing for a range of follow-up questions depending upon the answers

provided. These interviews took anywhere from five to fifteen minutes each and were

audio-recorded in all but two cases. For those two students, we took hand-written notes. Within a month of their completion, I had transcribed all of the recordings into Word documents and destroyed the original audio to prevent students' voices from ever being recognized.

Reflexivity and Data Analysis

As noted earlier in this section, it is essential in ethnographically informed work — and, indeed, in any qualitative research — to maintain an awareness of our own biases. Researchers cannot avoid carrying into a study a lifetime's worth of knowledge and socialization. The researcher's "lens" must consistently be turned "back onto oneself to recognize and take responsibility for one's own situatedness within the research" as well as the effect this might have on the people being studied, the setting, and the methods themselves, including the interpretation of data (Berger, 2015, p. 220). It is worth noting then that my own research has been informed by two extensive and challenging experiences. First, the motivation for this study stems from the sudden onset of a loved one's panic disorder in 2016. The details of this story are not mine to tell; however, that disorder ushered in a long, exhausting journey towards greater wellness. What I learned along the way — about mental health, about access to care, about school resources, about mindfulness and meditation, about therapies and medications, and about the financial costs of professional support — set me on this particular path and propelled me forward when I occasionally misplaced my sense of purpose.

Second, the value of my own mindfulness practice was quite suddenly and vividly apparent to me as I used it to cope with a health crisis that has permanently damaged my vision. Part of my recovery from multiple retinal surgeries that began in early 2018 involved being as still as possible for weeks on end. Strangely, all that I had been learning since embarking on this project helped me to endure that enforced stillness, and the stillness deepened my understanding of mindfulness in the most visceral way. Over the course of the last two years, I have relied on my personal practice to help me through the most difficult times.

These two experiences could not simply be parked at the door while I conducted research. Instead, the research had to be "reflexive". I had to "work with what knowledge [I had], while recognizing that it may be erroneous and subjecting it to systematic inquiry where doubt seems justified" (Hammersley & Atkinson, 2007, p. 15). To aid in this process, I kept two detailed reflective journals throughout the study. One focused on how each lesson's experience could shape future sessions; the other became a repository of musings, introspection, and reflections that, in part, helped to shape the research itself. This meant that the data analysis stage was somewhat integrated into the data collection stage of the research in a recursive manner that is common in ethnographic work. These journals were also helpful in the final stage of data analysis, the bulk of which took place after the program's completion. Finally, journalling in this way helped me to maintain an awareness of my own biases towards the efficacy of mindfulness practices in general and the ways in which I mitigated those biases through the triangulation of data by both source and type.

Themes and Interpretations

      Once all of the interviews, reflection journals, and field notes were transcribed into Word documents, I uploaded them into NVIVO 12. All photographic documentation was also curated, catalogued, and inputted into NVIVO. Initially, I created only two case nodes to capture data related to 'making' versus 'non-making' sessions. I also created nodes for each of the eight session numbers and entered the student-participants as individual cases, with attributes of interest being sex and group assignment. From that point on, I assigned data to nodes only as I identified them through multiple close readings of each document, pausing to rearrange and regroup nodes into larger categories and reassigning them where necessary. Throughout this intensive process of critical assessment and continuous reflection (Hammersley & Atkinson, 2007), I searched out patterns and thematic links to inform my overall interpretation of the data. One distinct set of patterns I found through this process had to do with the way in which students could be grouped according to their experiences with MakerMinds. Certain commonalities present in the students' experiences — both as they participated in making and in their uptake of mindfulness — produced four distinct themes of engagement. Findings related to these themes are found in chapter five along with a detailed explanation of how they were identified. Finally, with my research questions in mind, I focused the interpretive process of assessment and reflection on the ways in which the two pedagogies of mindfulness and making interacted. Findings related to this aspect of the data analysis are found in chapter six.

This sense-making requires what Chang (2007) refers to as "holistic insight, creative mixing of multiple approaches, and patience with uncertainty" (p. 9) leading to "what are, for the most part … verbal descriptions, explanations, and theories" (Hammersley & Atkinson, 1983, p. 3). In the final written product, ethnographic sense-making must be rendered as transparently as possible with the "full range of evidence" revealed upon which "the author's interpretive analysis is based" (Erickson, 1984, p. 145). It is only by virtue of this transparency that a researcher using this approach establishes the trustworthiness of her final report and manages to welcome the reader into what Erickson (1984) has described as the role of co-analyst. Beginning, perhaps, with the triangulation of data by source and by method, trust is then bolstered by ongoing reflexivity and the inclusion of participants' and the author's voices. The validity of the research is only secured, however, through qualities of the writing that immerse the reader into ethnographic scenes with rich detail and thick description. It is towards this challenge that I turn my attention in the upcoming chapters.

Participants and Location

The MakerMinds program was aimed at junior level students for a number of reasons. First and foremost, the years between 9 and 12 represent a transitional period from childhood to adolescence. Transitional periods such as this are thought to contain intensified developmental demands and difficulties and "can be considered phases of heightened vulnerability or risk" (Maloney et al., 2016, p. 314). Puberty brings with it a host of challenges — including sudden increases in emotional reactivity, self-

consciousness, and pressures associated with social groups and hierarchies (Gouda et al., 2016; Larson, 2011; Steinberg, 2007). In addition, adolescence is the most common period for the onset of a multitude of mental health issues (Kessler et al., 2005; Lee et al., 2014; Paus et al., 2008). Thus, by the time youth hit full adolescence, they need skills in place to alleviate stress and to manage intense emotions that can otherwise commandeer their attention and behaviour (Dahl, 2004; Larson, 2011). The pre-adolescent years — from 9 to 10 — therefore represent a "window of opportunity" in which "positive development can be cultivated … through [experiences] … that "promote" success and serve as "protective" factors" for navigating the path to adulthood (Schonert-Reichl & Lawlor, 2010, p. 4).

Beyond this, the promotion and maintenance of mental health is explicitly indicated by the Healthy Living Strand of the Health and Physical Education curriculum for the elementary grades, including grade four (Ontario Ministry of Education, 2010; 2015) and the program fosters several of the 21st Century Global Competencies identified by the Ontario Ministry of Education, including self-directed learning and collaboration (Ontario Ministry of Education, 2017; Hughes et al., 2019). The neurophysiological content of the MakerMinds program also functions as an appropriate part of the Understanding Life Systems strand of Ontario's science curriculum and prepares young students for the Human Organ Systems topic in grade five (Ontario Ministry of Education, 2007).

There is also the pragmatic issue of access. From years of volunteering for field trips and school events at my children's elementary school, and from my work as an

occasional teacher, I am known to a number of administrators and teachers in this particular school board and to those at the Albert Classum Elementary School in particular. The naturopathic doctor and certified yoga instructor who acted as a research assistant and facilitated the program with me, is also well known at this school through her own children and her volunteer activities. It therefore made sense for me to approach this local elementary school with my research proposal where it was greeted with enthusiasm by the principal and several teachers, one of whom agreed to open her classroom to this intervention. I therefore implemented the MakerMinds program with a class of 26 grade four students (24 agreed to participate in the study), ages 9 to 10, in the school's library/makerspace — known as 'the Learning Commons' — in April and May of 2019.

Designing the Intervention

MakerMinds was designed to blend together the generally accepted principles of makerspace pedagogy described in chapters two and three (Blikstein, 2013; Halverson & Sheridan, 2014; Sheridan et al., 2014) with the so-called 'classical' elements of any mindfulness training program (Flook et al., 2010). The mindfulness content was based upon the widely studied and highly successful MBSR program created in 1979 by Jon Kabat-Zinn, with the adult-centric language adapted to suit the comprehension levels of grade four students. This was supplemented by close readings of several other well-known mindfulness programs for young people, including the MindUp program

(Hawn Foundation, 2011), InnerKids (Flook et al., 2010), and Learning to BREATHE (Broderick & Metz., 2009).

My own understanding of this 'classical' content comes from extensive reading in the field as well as first-hand experience with the MBSR course and a long-held (though often interrupted) personal meditation practice that began approximately 25 years ago. Unquestionably, my experience with and enduring interest in mindfulness meditation was helpful in shaping the content of this training program, but I am also aware that I brought with me to this project considerable bias towards the efficacy of mindfulness in general. I therefore worked to mitigate this bias in a number of ways. I triangulated my data both by source and by type; I kept two separate reflective journals throughout the research study; and I was careful not to let personal opinions about certain common and accepted mindfulness practices affect their inclusion in (or exclusion from) the MakerMinds curriculum. Finally, I drew consistently upon the feedback of my co-facilitator who contributed significantly to its development. All of this involved a reflexivity that is considered to be a "core characteristic of qualitative research" (Creswell & Creswell, 2017, p. 200).

The Outline

In general, participants in the MakerMinds program learned what mindfulness is (both as a construct and in relation to human neurophysiology) and how its various techniques can be used to understand and manage thoughts and emotions, reduce stress, and promote overall mental wellness. Over many weeks, I carefully translated

these overarching goals into the skeleton outline of what I hoped would be a fully engaging curriculum. In the week leading up to each session, I then worked with my co-facilitator to transform this outline into a detailed script that could readily be carried out together. The careful scripting was important for a number of reasons. It allowed us to rehearse the lessons to fix timing and clarity issues before they arose in the session itself. It ensured that both facilitators stuck to elements of language and behaviour chosen deliberately to reflect the pedagogies in use. And, finally, a detailed script encourages careful revisions based on experience and even replication, should the need ever arise. Reflexivity was built into this process in two ways. First, I relied upon the feedback of my co-facilitator in two weekly discussions, one immediately following each session and another prior to the next session. Second, I kept the aforementioned reflective journal throughout the intervention in which I recorded my own reactions to each session and potential improvements that could be made to the following week's script.

I was fortunate that the amount of time allotted to this program — eight weekly blocks pre-arranged with both the classroom teacher and the teacher in charge of the Learning Commons — was in keeping with the number of sessions typical for an MBSR program (Gouda et al., 2016). Four of the sessions were short (that is, one school period of approximately 55 minutes) and four of them were long (two school periods of approximately 110 minutes, though this was reduced to roughly 100 minutes in practice). The four long sessions were 'making' days, and these were interspersed by three of the short sessions, which were 'non-making' days. I chose this particular

structure to enable comparisons between the 'making' versus 'non-making' days, with the aim of producing insights into how mindfulness training might be meaningfully supported and/or enhanced by makerspace pedagogy. The final short session (session eight) was used as an 'open house' for the parents, guardians, siblings, and peers of the student-participants.

The Repetitive Structure

To expedite the creation and delivery of this program, I divided all eight sessions into easily identifiable activities that were repeated each week in the same order. With this repetitive structure, students quickly learned what to expect from the individual activities and from the program overall. The repetitiveness also helped to smooth transitions between activities and encourage students to feel comfortable with our expectations. Thus, every session began the same way: with a *Check-in* that served as a welcome and a review of the previous week's content. When the students entered the quiet warmth of the Learning Commons, we (as co-facilitators) were already waiting in front of a large screen at one end of the room. Students dropped their coats and backpacks into an unused corner and gathered in front of the screen, sitting cross-legged on the carpet with hands in laps or stretched out on the floor. As we waited for everyone to arrive — they were travelling from a portable and often straggled in late — we would chat with those present or, as the program progressed, lead them in the use of a mindfulness tool. Behind us, a bright yellow and white slide lit up the screen, greeting the students with "MakerMinds" followed by that day's session number. Once

the *Check-In* began, we held the students' attention with two or three slides from the week before as we reviewed what we had previously learned. If the students arrived quickly to the Learning Commons, we were able to take our time with this introductory activity and include a good discussion of their homework. If they arrived late, as often happened, we cut our discussion short and saved these precious minutes for the content ahead.

After the *Check-In*, we proceeded with the *Mindful Moving* activity during which my co-facilitator (who is also a certified yoga instructor, though we were careful to avoid the somewhat loaded and non-secular term 'yoga') led the students in various stretches, poses, and contemplative movements. While designing the program, we were careful to ensure that each activity related as much as possible to the content of the day. The aim was to form a cohesive session, one that made holistic sense to the participants. Session four, for example, was all about developing sensory awareness, and that day's *Mindful Moving* activity involved a walking meditation that had students in sock feet, walking as slowly as possible along invisible balance beams as they brought their awareness to the individual sensations of each step. The *Mindful Moving* activity was then followed by a *Meditation*. Again, this was led by my co-facilitator who is far more experienced than I am in leading meditations. Each week we chose a different type of meditation from those most commonly introduced in beginner mindfulness programs. Our students therefore experienced a body scan, full-belly breathing, a guided meditation, a 'special place' meditation, a listening meditation, and concentrative meditation. This latter method is perhaps the one most people think of when they

envision meditating. It involves using an object of awareness — usually one's own breath — to focus the attention. Given its importance in the field, we taught this method twice.

At this point in the session, students were ostensibly comfortable, focused, and ready for the day's *Core Content* which would take us anywhere from 10 to 20 minutes to deliver. This activity was carried out by both facilitators and was always augmented by sets of carefully planned slides that provided much-needed visual depictions of complex ideas. The *Core Content* was the most difficult part of the curriculum to design, by far. It involved a host of challenging decisions around what constitutes the essential (or 'core') aspects of teaching mindfulness, what could be left out given our limited time, and how best to communicate each concept. Often this meant coming up with clarifying metaphors, visualizations, and stories, or finding a creative way to foster students' understanding by, for example, having students act something out (like how neurons carry messages through the body when we touch a hot stove). My intention was to foster understanding amongst a diverse group of learners by approaching the content in a variety of ways. This was no chalk and talk. Whether it was a 'making' day or not, we employed active learning strategies aimed at fully engaging the students in understanding mindfulness, both conceptually and experientially. We began by looking at the brain and how the amygdala, the pre-frontal cortex, and the hippocampus work in terms of reacting to and managing stressful moments. In addition to sharing the related colourful slides, we passed around a model brain for the students to manipulate and ponder. After that, the *Core Content* included such topics as: *Thinking about Thinking;*

Where We Feel Emotions; *The Nervous System*; *Brain-Body Connections*; *Responding versus Reacting*; *Why Does My Stomach Hurt? (All about the parasympathetic and sympathetic nervous systems); All about Kindness;* and, *What's in my Toolbox? Let's Review.* Together, these topics addressed the three intersecting themes identified in the MakerMinds explanatory documents provided to school administrators and parents before the start of the program: mindfulness, neurophysiology, and metacognition. Please see Figure 1.

Figure 1
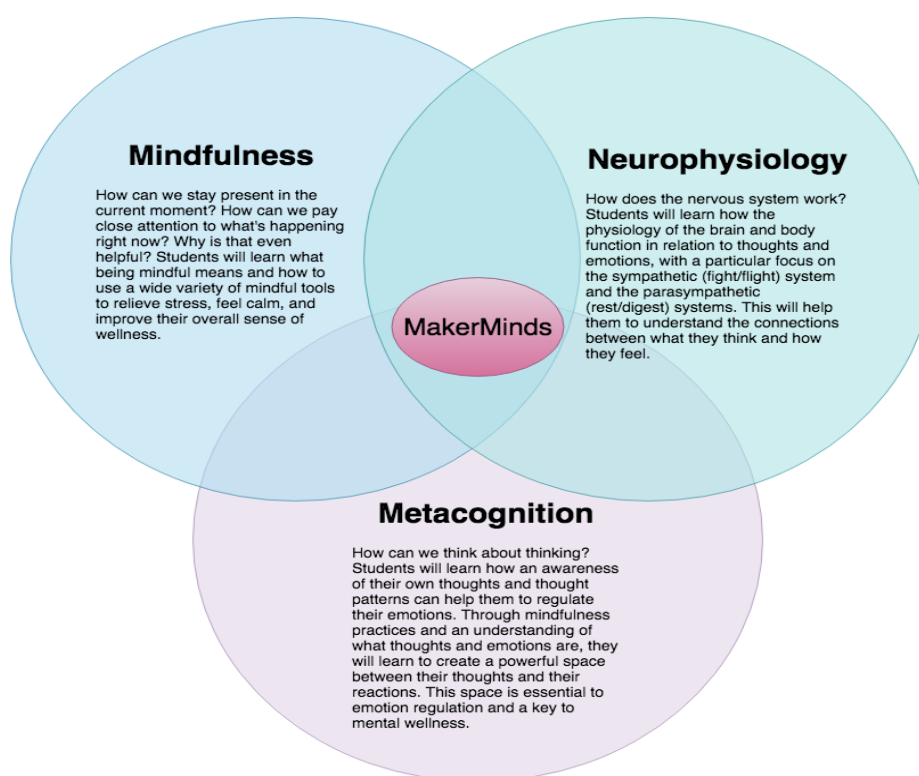
In the four long sessions of the program students engaged in the integrated pedagogies of making and mindfulness. That is, the *Core Content* was followed by a *Making* period of approximately 45 to 55 minutes, with time allowed for cleaning up. For this activity students worked together in one of six small groups, lettered A through

F, pre-assigned by their classroom teacher. Their goal was to create a number of physical representations of the brain-body processes affecting their mental well-being. Each group's models were to be collected together into one life-sized human cutout that they would share during the open house in session eight.

Throughout the program, the *Core Content* (i.e., the lessons in mindfulness and neurophysiology) were therefore connected to this ongoing project-work (i.e., the making). At the same time, the project-work aimed to reflect and develop participants' understanding of the *Core Content*. This connection between learning mindfulness-related physiology and then making models of that physiology was central to the entire curriculum. Thus, in the first session, students worked in their groups to make model brains based on what they had learned earlier in the period. They also traced a group member's outline onto a sheet of light-brown butcher paper. These would become the life-sized human cutouts that were — rather mysteriously — dubbed the 'buddies'. It was a name that stuck. For time and safety reasons, we took these outlines home and cut and spray-glued them onto large sheets of painted cardboard, returning them to their groups as blank 'buddies' in an exciting third session. Also in this third session, students made neurons and began attaching their models to their 'buddies'. In the fifth session, they worked on a spinal cord and nervous system. And in the seventh session, they lit up their 'buddies' by fitting them with LEDs attached to switches. In keeping with makerspace pedagogy, each of these *Making* periods was structured so that students were free to move about the room, engage with their peers, and use whatever materials were available in whatever manner they deemed fit in order to produce the

physical representations of their learning. Paradoxically, creating an environment in which students feel free to explore and build requires some serious organization. Thus, at the start of the *Making* activity students were invited to proceed to their tables, each of which already sported a card with their group letter on it. These letters matched the ones on the students' lanyards. Every table also held a basket containing a set of tools

Figure 2 - Waiting for students to arrive in the Learning Commons for session seven. May 2019.

and materials, like glue, clay, scissors, and tape, that were also marked by the group's letter. This helped to prevent supplies from disappearing as the program progressed. By the third session, the 'buddies' also awaited their students (see Figure 2). In one corner of the room stood a counter-height materials table, enticingly covered by a sheet. On this table we arranged a buffet of materials — beads, elastics, felt, pipe cleaners, popsicle sticks, cardboard, card stock, yarn, playdough, paints, brushes, chalk, markers,

cloth, pasta, and pompoms, amongst other items — all in a variety of colours and sizes. As a side note, we made an attempt to reduce our environmental impact by re-using items we collected at home, like milk tags, old twist ties, and cardboard tubes. We also re-used glass jars and plastic containers to display and contain the materials. Though this wasn't overtly discussed with the students, it was in keeping with the school's culture of environmentalism. Our materials table was only uncovered once the students were seated quietly enough to hear a brief set of instructions reminding them of what they were making that day and of the freedom they had in making it. Their teacher then sent each group up to the materials table one at a time. We — the teacher and facilitators — stepped back at that point and let the students get to work. Our job was simply to facilitate the making where necessary and furiously jot down field notes.

Makerspace pedagogy generally involves a range of low- to high-technological tools and supplies (Blickstein & Worsley, 2016; Halverson & Sheridan, 2014; Sheridan et al., 2014). The MakerMinds program therefore involved the students in building simple electrical circuits in order to add one to two LEDs to any aspect of their human models they wished to (literally) highlight. Ideally, I would have preferred to provide the materials for this element of the project and allow students sufficient time to integrate working LEDs into their models in an entirely student-led manner. However, there simply wasn't enough time for this to happen. Instead, based on earlier observations, I chose to scaffold the learning carefully to ensure that all students had a chance of participating successfully in the final 'making' session. I therefore used much of session six to lead the entire class through a highly organized lesson on circuitry while still

allowing as much student-led discovery as possible. We provided each of the regular 'making' groups with a kit containing pre-stripped wires, pre-soldered switches, coin batteries, and LEDs. I then asked all of the students to light up a single LED using a coin battery. They were given enough time to work this problem out for themselves or to learn from their peers. When they were all holding a working LED, we moved onto Simple Circuit #1. There were enough supplies and laminated diagrams provided for every student to attempt this circuit alone. Students were asked to copy the diagram in order to connect two wires to a coin battery and an LED. After sufficient time, we finished the lesson with Simple Circuit #2 which built on what the students had learned with the first circuit, but also included a switch. There were only enough of these pre-soldered switches for each group to attempt two connections, so students worked in pairs and groups of three to accomplish this task. By the end of the session, students were both prepared and excited to 'light up their buddies' on the final 'making' day.

The *Making* activity was followed by a *Mindful Practice* during which we guided students in the use of various mindfulness techniques. In the short sessions, of course, there was no *Making* period and the students moved directly from the *Core Content* into the *Mindful Practice*. As with the rest of the curriculum, the *Mindful Practice* was meaningfully connected to the day's content whenever possible and we covered a variety of 'tools' the students could use when needed. For example, in session four the core content focused on reframing negative thoughts into positive ones and that day's *Mindful Practice* was called 'Five Good Things Before Bed'. As the name implies, this exercise asks participants to think of five good things that happened during the day

before going to sleep. Other similar practices we covered included the Five Senses

Exercise, Square Breathing, and Finger Breathing, all of which we added to our

'toolbox' of meditations students could use whenever they needed a way to calm

themselves or feel better. By the end of the program we turned this metaphorical

toolbox into a physical one filled with laminated diagrams so that students could easily

share their favourite tools with visitors at the open house.

The final activity in each session was a time of *Reflection* during which students

took a pencil and their preformatted journals to any quiet corner of the Learning

Commons and spent up to 10 minutes reflecting upon the day's session and answering

the questions provided (see Appendix C). These journals formed a key piece of my data

collection. The students then lined up at the door to leave with their teacher and we

reminded them of their homework for the coming week, which was always to practise

the mindfulness tool they had just learned.

Flexibility and an Emerging Curriculum

Though I was thankful for the amount of time allotted to the MakerMinds

program by the classroom teacher, it still formed a constraint that impacted what we

could and could not accomplish. As an experienced teacher, I have encountered this

frustration repeatedly. There is simply never enough time to include all of the content a

teacher hopes to cover in any given class, so we prioritize and trim and try to build

extra time into each period to cope with inevitable interruptions to our schedule.

Understanding this helped me to build a thorough and workable curriculum, but no

amount of planning could prevent unexpected disruptions. I therefore considered my curriculum to be a working document that had to remain flexible, and my co-facilitator and I made changes on the fly as we responded to disruptions, assemblies, last-minute schedule changes, and the simple fact that some things take longer in reality than they do on paper. Aside from the previously mentioned *Check-in* that was repeatedly impacted by students' late arrival, two activities in the curriculum were more affected than others. Very quickly we discovered that there was never sufficient time to accomplish what we wanted during the *Making* activity and so we decided by session three to remove the *Mindful Moving* activity from the 'making' days. This made sense because the students spent so much time during those sessions moving freely about the room. The *Mindful Practice* was the other activity most affected by time pressure. In the first session, for example, we had to skip it altogether and add it instead to the second session. In session seven we again skipped the planned *Mindful Practice* in order to give sufficient time to preparing for the open house (see Table 1). Despite these changes, we managed to fit a satisfactory variety of mindfulness tools into the program.

Seeing the curriculum as a working document also made room for me to reflect upon the experience of each session and use what I had learned to help build the next. During the first week's session, for example, I learned that students could take up to 10 extra minutes to get from their portables to the Learning Commons. I therefore pared down all of the following weeks' *Core Content* by several minutes and prepared myself to leave out certain review slides during every *Check-In* if that proved necessary. By the

fourth session, I had pushed together *Mindful Moving* and *Meditation* so that they

flowed one into the next without interruption.

Table 1 – Program Structure (Including Changes)

Session 1 (Long) 'Making' Day	Session 2 (Short) 'Non-making' Day	Session 3 (Long) 'Making' Day	Session 4 (Short) 'Non-making' Day
❏ Check-in ❏ Mindful Movement ❏ Meditation ❏ Core Content ❏ Making ❏ ~~Mindful Practice~~ (removed due to time) ❏ Reflection Time ❏ Homework	❏ Check-in ❏ Mindful Movement ❏ Meditation ❏ Core Content ❏ Mindful Practice 1 ❏ Mindful Practice 2 (carry over from previous week) ❏ Reflection Time ❏ Homework	❏ Check-in (removed review due to time pressure but still checked in on homework) ❏ ~~Mindful Movement~~ (removed to allow more 'making' time) ❏ Meditation ❏ Core Content ❏ Making ❏ Mindful Practice ❏ Reflection Time ❏ Homework	❏ Check-in ❏ Mindful Movement & Meditation ❏ Core Content ❏ Mindful Practice ❏ Reflection Time ❏ Homework
Session 5 (Long) 'Making' Day	**Session 6 (Short) 'Non-making' Day**	**Session 7 (Long) 'Making' Day**	**Session 8 (Short) 'Open-House'**
❏ Check-in ❏ ~~Mindful Movement~~ (removed to allow more 'making' time) ❏ Meditation ❏ Core Content ❏ Making ❏ Mindful Practice ❏ Reflection Time ❏ Homework	❏ Check-in ❏ Mindful Movement & Meditation ❏ Core Content ❏ Mindful Practice ❏ Reflection Time (ran out of time so these were completed in classroom immediately following program) ❏ Homework	❏ Check-in ❏ ~~Mindful Movement~~ (removed to allow more 'making' time) ❏ Meditation ❏ Core Content (Review) ❏ Making ❏ ~~Mindful Practice~~ (removed to plan Open House) ❏ Reflection Time ❏ ~~Homework~~	

Though this minor change saved only a minute or two, my goal was always to fit

all planned activities into the class without appearing to rush through them. In practice,

this meant that we prepared each week's curriculum with notes attached about what we

could trim if (or rather, when) time was tight. This reflective practice affected much

more than timing, however. In some instances, it impacted the content itself. Following

session two, for example, I noted the apparent importance of building repetition of

essential concepts into the program. This note shaped the *Core Content* to come, ensured

that our review of challenging concepts took precedence during the *Check-in*, and

reminded us to practise mindfulness tools whenever possible. In my reflective notes on

the fourth session, I worried that teaching the mindfulness tool 'Five Good Things

Before Bed' didn't go as well as we had hoped. The activity was rushed and the

students' behaviour was difficult to interpret. Sitting silently with their eyes closed, it

wasn't clear whether or not they were fully participating in the exercise. This moment is

better captured in my field notes from that day:

> *At this point in the session it was very hard to tell how many of the students were*
> *actually counting good things that had happened to them during the day. We allowed*
> *them the time to do this silently. With more time, however, we would have asked them to*
> *share a few of their examples so that they could get a good idea of the variety of answers*
> *possible and how minor a thing could be and still be counted as a good event or a good*
> *moment. This is an important tool for them to learn, so [my co-facilitator] and I decided*
> *that we will begin next week's Check-In by reviewing this activity.*

(JEK Field Notes, Session 4)

Indeed, my field notes from session five show that we began the day by discussing 'Five

Good Things Before Bed' in more detail to ensure that students understood this

concept. Another major change resulted from my reflective notes on the *Making* activity

in session five. It was here that I realized that the students would never be able to learn how to build electrical circuits and also integrate them into their human cutouts on the same day. I therefore cut the original *Core Content* from session six and used this time to teach the simple circuits lesson instead. Maintaining a stance of flexibility and reflexivity was therefore essential in shaping a curriculum that best met the needs of students while adapting to unforeseen circumstances and the school system's constraints.

Conclusion

In this chapter, I explained why I chose an ethnographically informed approach to research by detailing its suitability in the exploration of MakerMinds. In particular, I highlighted how this ethnographic-style research produced nuanced understandings of complex meanings while pushing participants' voices into the foreground. I further described how I used multiple methods and multiple sources of data, how I mitigated potential biases through the triangulation of this data, and how I analyzed the data to make sense of the intervention and to shape the research process itself. I also situated myself within the research and discussed the reflexivity through which I tempered my own biases. Finally, I provided a detailed account of how the two pedagogies of mindfulness and making were integrated into this curricular intervention and the importance of flexibility and reflexivity in adapting the curriculum to the unforeseen needs of students and the school. In the next chapter, I turn to my first set of findings to explore the different ways that students engaged in the program.

Chapter Five: Findings

Four Themes of Engagement

At this point, the most obvious question to ask of this (or any) research intervention is, *how did it go?* This is, however, a deceptively simple question and shorthand for a multitude of others depending on who is asking and how much time they have for an answer. In this chapter, I aim to convey 'how the intervention went' in terms of how different students engaged with it differently. This requires an understanding of the richly detailed and nuanced experiences of the student-participants.

This chapter is therefore intentionally descriptive rather than analytical[7] and the findings are rooted firmly in the students' own words/actions. In addition to the observations of three researchers, I rely heavily upon students' reflection journals and post-program interviews by incorporating quotations from those sources as well as speech captured in class. Because ethnographic-style research "expressly facilitates the desire to engage with children's own views," I strive to make those views and ideas accessible to the reader (James, 2001, p. 247). To distill eight weeks of 24 student experiences into an intelligible form is no simple task, however I attempted and discarded several prior versions of this story based on single case studies and composite

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[7] In the following chapter, I present an analysis of findings related to my research questions by discussing how the two disparate pedagogies interacted.

cases before realizing that a thematic framework would be the most inclusive format to use. By organizing this chapter thematically, I'm able to share an abundance of salient moments, thoughts, events, and opinions within a coherent structure.

Identifying Themes and Thematic Criteria

Through eight weeks of observation and multiple close readings of the data it became clear that there were certain characteristics in the way that each student appeared to experience MakerMinds that were held in common with other students. Indeed, through multiple initial readings of the data, I was able to identify four distinct themes, each one based on students' engagement with the makerspace pedagogy and their uptake of the mindfulness pedagogy: *Enthusiasts*, *Reticent*, *Distracted*, and *Builders.* These themes are meant to capture each group's most obvious and consistent behaviour relative to the other groups, however those categories are not static and the themes are presented in this chapter only as they appeared in this particular version of the program.

Each student's inclusion within a certain theme — along with that theme's title — should therefore be read as situationally dependent and not as an inherent characteristic of that person. With this in mind, I sketched a table of criteria for each theme. Subsequent readings of the data then led to the provisional assignment of

students, with some students temporarily tagged as more than just one type, the boundaries in this typology being somewhat permeable[8].

Just because a student is identified as *Reticent*, for example, should not suggest that he or she never exhibited enthusiasm for making. Likewise, a *Builder* could be distracted at times, and an *Enthusiast* could be shy about speaking up in class. What mattered was that the evidence of their behaviour over the eight weeks fit convincingly more with one particular group than with any of the others.

With the provisional themes assigned, I focused on one thematic category at a time. Again, I returned to the data. Through multiple readings of all documents related to each theme's provisional students, I was able to recognize and map in table form commonly displayed behaviours, observed characteristics, expressed opinions, ways of engaging in the making, responses to mindfulness, and use of mindfulness tools. I recorded this data in three tables per theme (see Appendices D to O). The first table (the Criteria Table) depicts the number of times each criterion appears in the data per student. The second and third tables helped to accurately fill out the Criteria Tables by tracking two important data points: positive/negative responses to the program and use of mindfulness tools. More specifically, the second table refers only to student reflection journals and depicts each student's responses to the positive and negative journal prompts (i.e., *'What things did you like about today?'* and *'What things did you NOT*

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[8] I include a more detailed discussion of the typology's permeable boundaries at the end of this chapter.

like about today?'). The third table also refers only to student reflection journals and depicts each student's use of mindfulness tools in the week prior to every session. This way, I clarified the criteria for the theme and amended its list of students.

A student's inclusion in a particular group was, in the end, based on identifying what I considered to be a minimum number of data points, and that minimum depended upon how many instances of each criteria were identified in the data. The *Enthusiast* Criteria Table, for example, (see Appendix D) shows that the criteria for this category included verbally participating in class, participating overtly in the mindfulness exercises, showing leadership skills in the making (including confident and/or controlling behaviour), and adopting mindfulness tools early in the program (i.e., by session three). I assigned one point only for participating verbally in class (some students spoke up a dozen times and I didn't think this criterion should be weighted too heavily). I assigned one point for *each example* of overt mindfulness participation and one point for *each example* of leadership, and then I assigned one more point for early adoption of mindfulness tools. When totalled, I included any student for whom I had identified at least four points. The final point totals for students in the *Enthusiast* category ranged from four to seven.

A similar process produced lists of the *Reticent* students, *Distracted* students, and *Builders* (see Appendices G, J, and M). At this point, I had a high degree of confidence in the lists based on the care and deliberation with which they were produced, as well as the fact that they were thoroughly rooted in the students' own words and actions along with multiple other sources outlined above. However, I sought to verify them by

sharing the criteria for each group with my co-facilitator who then categorized the participants' observed characteristics to the best of her ability. Independently, we achieved 87 percent agreement. Where our assignments differed, we discussed our observations of that particular student until we reached full agreement on his or her most appropriate thematic placement for the purposes of this descriptive chapter.

The Enthusiasts

Cam, Cecilia, Esther, Hannah, Isaac, Kai, Kristin, Marie, Max, Nadia, Noelle, Stefie, and Tyler

I begin with the largest and most conspicuous of the themes. Fully 13 of the 24 students in this study could best be classified as *Enthusiasts.* That is, they were all overtly eager participants in both the mindfulness and makerspace pedagogies from the beginning of the program through to its end. To be fair, distinguishing between the *Enthusiasts* and the rest of the class was, in part, a matter of degrees because the program was very well received by most of the study's participants. Most students appeared to be interested and generally on-task throughout the eight sessions of the program. So, amongst a classroom of mainly amenable and cooperative students, what made these 13 students stand out? It was their observable eagerness to partake in both pedagogies, the leadership role they took on in their maker groups, and their early adoption of the mindful practices that separated them from the rest of the class, keeping in mind, of course, that there were degrees of enthusiasm even within this group (see Appendix D). Additionally, most of these students were vocal in class discussions and

— like most participants — they were overwhelmingly positive in their response to the program.

Enthusiasm for Mindfulness and Making

During the contemplative practices, this group helped to set a positive tone by sharing their enthusiasm with their peers. In one of the first mindful movement exercises, for example, Cam led the class in adding a loud clap to the top of the stretch as all of the students reached their arms up over their heads — something they then enjoyed doing for the rest of the program (JEK Field Notes, Session 2). That same session, Tyler vocalized his pleasure as he bent over to touch his toes, sighing, "Oh, that feels good," even though no other students were speaking and these activities were generally silent except for sighs and occasional giggles (NPO Field Notes, Session 2). In another session, Stefie followed along with the meditation in a way that broadcasted her approval of the practice. While her peers sat in various positions on the carpet, she meditated while sitting cross-legged on a chair "with her middle finger and thumbs touching as in the traditional meditation pose" (NPO Field Notes, Session 3). In a similar manner, Max carried out his meditation in session four with "his legs crossed like he was in a traditional meditation pose" (NPO Field Notes, Session 4) and again in the next session while "seated in a typical meditative posture with thumbs and fingers on the knees" (JEK Field Notes, Session 5).

During one of the mindful practices, when asked to imagine happiness in the form of a room full of puppies, Nadia "shook her hands in the air in a joyful show of

anticipation" (JEK Field Notes, Session 2). And, in one of the later sessions, Isaac stretched and yawned loudly at the end of a meditation so that other students turned to see him smiling and looking relaxed (NPO Field Notes, Session 6). This is not to say that enthusiasm for mindfulness was only present when indicated by outward expressions like those listed above. However, mindfulness pedagogy often requires stillness and/or silence such that interpreting related observations was challenging. Were the students sitting cross-legged with closed eyes actually meditating along with their guide or were they daydreaming? Were the quietest students most focused on the moment at hand or were they listening to the shuffling of their peers? Indications of genuine and eager participation were therefore rare. Moments like those listed above were notable because they were outward expressions of enthusiasm for quiet, restrained activities but also because these expressions helped to create a positive atmosphere for the mindfulness activities.

Much less challenging to capture, and therefore perhaps more telling, was this group's enthusiastic uptake of the making activities. From the very first moment that the class was introduced to what the making actually entailed — freedom to move around, to talk, to laugh; free access to a table full of interesting materials; and freedom to create models in whatever manner they saw fit — they were all excited. After all, the making was meant to be engaging and it was also a novel experience. As one (non-*Enthusiast*) student put it, the 'making' days were his favourite "because you [got] a chance to collaborate and also learn as well and [we have] just really never done this sort of thing before" (Jacob's Interview).

Leadership Roles

Once again, the *Enthusiasts'* behaviour stood out, not necessarily because they were more interested in the making, but because they were more overtly engaged in it. Their eagerness was perhaps most clearly depicted in the leadership role the *Enthusiasts* took on in their own maker groups. As Cam indicated when he wrote, "I learned that I have to step up and be a leader" in his first journal response, these students took charge (Cam's Journal 1). In the following making sessions, Cam did indeed take on that leadership role. Though he struggled to keep himself involved and separate himself from the distracting behaviour of certain boys in the class (see CF Field Notes, Session 6 and 7), he also tried hard to keep his group on task. He was "using 'good job' and other encouraging words with his group members" (CF Field Notes, Session 3) and "trying to break up the workload by telling Hannah and Carmella they should make the nerves" while the boys worked on something else (NPO Field Notes, Session 5).

Similarly, Esther wrote in one of her journals: "I learned that I like to be a leader and be the person that likes to get everyone back on track" (Esther's Journal, Session 5). Max also "seemed to be at the centre of the [making] activity" (JEK Field Notes, Session 3) and was full of ideas of what their group should do. He told them, "We're going to make branches" and then suggested using clay to connect the branches together (NPO Field Notes, Session 3). Noelle was overheard telling her group, "We need to cooperate; you can't just make things without talking about it." She said this without any anger in her voice; instead simply explaining how they ought to proceed (JEK Field Notes,

Session 3) and she was later observed "helping to guide her group on what they were going to do with the thick and curly yellow yarn" (NPO Field Notes, Session 3).

Perhaps less gently, Isaac tried to keep his own group members in check when he called out, "Can you stay on task?" (NPO Field Notes, Session 3). Indeed, it was often the way that the *Enthusiasts* interacted with non-*Enthusiasts* in their maker groups that made their leadership role most evident. When Noelle needed assistance fixing her group's circuit, she recruited Liam (a non-*Enthusiast)* to stand nearby handing her wires and other materials (NPO Field Notes, Session 7). When Mason "asked Nadia if what he was doing was okay" he waited for her assurance, "Yeah, that's actually really good" before continuing (NPO Field Notes, Session 5). Kristin also took charge when she noticed that another group member needed assistance: "She called out to Marie, 'Can you help Maya?' Seeing that her peer was already busy explaining their work to the teacher, she said, 'Never mind, I'll help her' and she moved around to the other side of the table to help Maya [a non-*Enthusiast*] place white beads on the board" (JEK Field Notes, Session 5).

At other times, their help was less welcome, like when Marie explained to Maya that they had to damage the heart she had just made in order to put the LED through it. In my field notes, I wrote that "Maya watched unhappily as the other students worked to put a hole through the buddy's red paper heart. It worked well, however, and they managed to push the LED carefully through the hole and light it up" (JEK Field Notes, Session 7). At that point Maya seemed pleased that she had helped her group with a significant aspect of the making.

Confident Behaviour

Throughout the program, *Enthusiasts* expressed a degree of confidence that helps explain their tendency to take a leadership role within their own maker groups. For example, in an early journal response, Hannah was already convinced that she had "grate things to contribuot [sic]" to the program (Hannah's Journal 1); Nadia told me that their brain model was "a really good one and she really liked it" (JEK Field Notes, Session 1); Esther felt that she had "a certain talent for modelling [clay]" (Esther's Journal, Session 3); Marie said that she was "great with clay" (NPO Field Notes, Session 3); and Cecilia reflected that she was "way more creative than I thought" (Cecilia's Journal 3). At times, these students demonstrated their confidence through their behaviour more than through what they said or wrote. In session four, for example, Stefie took it upon herself to rearrange the class during a mindful practice. She called out, "Can we all move back so we can fit?" and everyone moved backwards a few steps to form a larger circle (NPO Field Notes, Session 4).

At the open house, both Tyler and Nadia volunteered to explain all of the mindfulness tools on the display table to a small group of adults (including the school trustee) (JEK Field Notes, Session 8) while Noelle was observed several times explaining the various stations to adult and peer visitors (NPO Field Notes, Session 8). And Max was observed "proudly" sitting by his 'buddy' "answering questions about why they lit up the amygdala and sharing [his] favourite mindfulness tools with the guests" (JEK Field Notes, Session 8).

Sometimes it was difficult to assess whether this confident behaviour was in fact more about seeking attention. Kai, for one, regularly raised his hand to answer questions. When he was picked, he would often take that opportunity to say something surprising and then smile at the consternation this caused amongst his peers. He insisted that he "did full belly breathing in his sleep" for example, and this "caus[ed] confusion and chatting amongst the class" (CF Field Notes, Session 6). He also told everyone that "puppies make him angry" after an exercise about feeling happiness and, in another class discussion, he said that he "wanted to kick and punch his sister" but used mindfulness not to do it (CF Field Notes, Session 3).

Stefie's behaviour could also shift between appearing confident and appearing to seek attention. In session seven, in particular, she sat to one side as her group members struggled to attach the circuit to their 'buddy'. Referring to tape, she shouted instructions at them "Use five pieces! No, use ten," without attempting to cut those pieces or hold things in place while the others did the taping (JEK Field Notes, Session 7). Later that same session, she "suddenly climbed up onto the table with the buddy in order for her peers to be able to work on the underside." I took a photograph right after intervening for the sake of her safety. In it, Stefie is no longer standing. Instead, she is seen from the back, kneeling on the table while holding their buddy upright. In my notes, I wrote, "Though fun for her, this behaviour was distracting and entirely unnecessary" (JEK Field Notes, Session 7). I struggled somewhat with whether or not these examples pointed more to attention-seeking behaviour than to confidence but

settled on the idea that they at least required a certain amount of boldness and they were also open displays of enthusiasm for participating in the program.

Controlling Behaviour

At times, the confidence and leadership skills displayed by this group of *Enthusiasts* crossed a line into behaviour that was more about controlling others than it was about guiding them. In other words, some of these students explored a mode of leadership that could be downright bossy. When one of her group members wanted to use glue instead of double-sided tape to attach their model brain to the cutout, Nadia, for example, stated with finality that they weren't doing that and that they would be using the tape (NPO Field Notes, Session 5).

When I checked later, this group had indeed used the strong double-sided tape to attach a heavy multi-coloured clay brain to the cardboard. When Hannah didn't like the way that "Fred" was written across the bottom of their cutout — all of the groups ended up naming their buddies — she instructed one of her group members to redo it. This girl quickly complied without argument (CF Field Notes, Session 5). That same session, Hannah expressed irritation with group members who weren't able to get the corks to stick the way they wanted as they worked on building a spine. "If it doesn't work, then just move on," she said with "an irritated tone to her voice" (CF Field Notes, Session 5). And when Stefie disagreed with another group member about the placement of their LED, she repeated several times that they were "putting it in the amygdala" and that's where it ended up going (JEK Field Notes, Session 7).

This controlling type of leadership behaviour could also be less confrontational and more a matter of simply undoing the work of others. Kai and Cecilia, for example, covered up what another group member drew when they didn't approve of what had been added to their human cutout (NPO Field Notes, Session 7) and Marie replaced a group member's painted eyes with googly ones without asking her permission (NPO Field Notes, Session 3). Isaac's behaviour, in particular, stood out in this regard, captured in the following field note:

> *Michael was busy making the face of Group B's buddy. He was trying to make a moustache when I stopped to watch and he couldn't decide which way it should go, curled upwards or downwards or straight. He asked for my opinion. I told him they all looked good so he would have to decide. In the end, however, I saw that there wasn't a moustache attached. Isaac wasn't letting Michael decorate the face the way he wanted to. He had decided on adding a thick unibrow, which was meant to be funny. Isaac said, "Why are you putting on a unibrow? Stop decorating." This was meant as a direction; it wasn't said in fun. Michael didn't seem to react at the time and he kept working at the decorating, but Isaac had a clear idea of the way he wanted the face to be and he wasn't letting Michael have a say. There was no anger apparent, but perhaps some quiet frustration. Whatever Michael put down on that face, Isaac "fixed".*

<div align="right">(JEK Field Notes, Session 5)</div>

Finally, as a mode of leadership, the controlling behaviour was at times about excluding others from the work at hand. Tyler, for example, wouldn't let one of his group members help with adding a mouth to their cutout (JEK Field Notes, Session 5). And, when a group member asked Kristin what she was doing, she explained that they had to pull the nerves apart to fix them. Then she added, "We have to make a new [nervous system]. Well, *I'm* making a new one." In my notes I clarified that the emphasis here was on the 'I'm' "as if to state that the other child was not welcome to help" (JEK Field Notes, Session 5).

Responses to the Program

With their consistent eagerness to partake in activities and their varying leadership roles within the maker groups, it is not surprising that the *Enthusiasts* were overwhelmingly positive about the overall program. This was clear from their journal responses (see Appendix E). Of the 13 students in this group, all but four filled out a reflection journal for every session (there were no journals in session eight). Of the four who did not complete all of the journals, three students were away for a day (Esther was away for a day and also missed the journal writing part of another session) and one simply didn't fill out a response for the first session. Excluding the five absences then, that left 87 possible positive responses to the question, *What things did you like about today?* and this group of students produced 85 positive answers. Some of these were quite detailed, like Cecilia's:

> *I really liked building the brain. We started off struggling but then we did really good. Also, I really liked the slideshow and the stretching. The slideshow I learned a lot from. The stretching made me tired which is a good thing and I think I will stretch before I sleep since I'm not getting enough sleep.*
>
> (Cecilia's Journal, Session 1)

Others were less detailed, like Isaac's. He liked "That we made neurons with different materials and got to be creative" (Isaac's Journal, Session 3). In terms of negative responses to the sessions, the students were asked, *What things did you <u>not</u> like about today?* This time, the *Enthusiast* group produced only 31 answers and these "negative" responses included several about preferring 'making' over 'non-making' days, like Kristin's: "We did not get in our groups and do our decorating" (Kristin's Journal,

Session 4) and Kai's who didn't like "[s]itting for a long time" (Kai's Journal, Session 2). There was also a range of negative responses. Nadia, for example, wrote that she "did not like how people were humming too loud" (Nadia's Journal, Session 5) and Cecilia wrote that she "got stuck in the yarn then everyone started getting stuck. First it was funny and then it was chaos" (Cecilia's Journal, Session 5).

On the other hand, Noelle expressed her more serious frustration with the lesson on circuitry when she wrote, "I did not like that sometimes the lights did not work. It was very frustrating" (Noelle's Journal, Session 6) and all three of Tyler's negative responses were about his frustration with people who were "goofing around" in his maker group (see Tyler's Journals, Sessions 1, 3, and 5). It was also striking that, without any prompting or discussion, most students in this group turned that second question about negatives on its head by answering with a positive response. This happened 51 out of a possible 87 times. These answers ranged from "Nothing really, I had a great time!" (Kristin's Journal, Session 5) to "I can't think of something I didn't like" (Isaac's Journal, Session 4) to my favourite endorsement of the program: "I did not not like anything" (Kai's Journal, Session 7). In the final tally then, this group produced 136 positive responses where only 87 were requested and only 31 actual negative responses.

Uptake of Mindfulness

Perhaps most importantly, this group's enthusiastic uptake of the program manifested in their early adoption of mindfulness practices (see Appendix F). That is,

by session four, all but one of the *Enthusiasts* had begun to incorporate mindfulness

tools into their daily lives and had indicated this through journal responses and/or

class discussions. In response to the journal prompt, *Tell me about a time when you used*

mindfulness in the last week, Isaac wrote, "I used square breathing because I was stressed

about math" (Isaac's Journal, Session 4). Tyler wrote, "I used it when I was mad at my

sister" (Tyler's Journal, Session 4). And Hannah was using mindfulness "When I go to

bed and when my family gets mad at me" (Hannah's Journal, Session 4).

Indeed, a full 85 percent of this group was already using mindfulness tools on

their own by session three. Cecilia, Esther, and Max were particularly advanced in this

regard. They were the first of this group to respond positively to this journal prompt as

early as session two. In that session, Cecilia wrote, "I used it during the last weekend";

Esther wrote that she used mindfulness "when I got really angry at my brother for

teasing me and I had to calm down"; and Max wrote, "I ust it to fall asleep every nit

[sic]".

Noelle, on the other hand, was a true outlier in this group. She did not respond

to this prompt at all until the fifth session when she finally wrote, "In my hockey

game." Though it's not clear why Noelle took longer than the others to embed

mindfulness tools into her own life, her inclusion as an *Enthusiast* was firmly

established by how often she was observed in a leadership role.

Several of the students in this group were also sharing what they had learned

about mindfulness with their families. Kristin, for example, told the class that she had

shared the square breathing tool with her Mom when she was angry (CF Field Notes,

Session 6). In a post-program interview, her mother explained that Kristin had been practising the tools "more in the evening when she wasn't stressed" but that Kristin "ha[d] also been showing me what she's learned and she wants to teach me how to do it." Stefie talked about sharing the tools with her parents (JEK Field Notes, Session 7) and using them to help her brother through lacrosse and hockey tryouts (Stefie's Interview). And Kai's mother stopped me at the open house to say how much her son had "loved" the program and how much he had taught his parents about it at home (JEK Field Notes, Session 8).

Finally, although the students were never asked directly about their overall response to the program, two of the *Enthusiasts* made their assessment perfectly clear. In his post-program interview, Tyler said, "Well, I learned the five senses, the square breathing, and I find the square breathing really helps me when my sister is mean to me. I use it. I also use the finger breathing before I go on the ice, and hockey. And I like doing yoga now." And in Stefie's interview, she had this to say: "I loved the arts and crafts. That was probably my favourite thing. I loved how there was so much crafts and so much interesting learning. I loved that there were tools about how you can calm yourself down. I have definitely used those."

Conclusion

I was so fortunate to have over half of the study's participants openly embrace the experience from the beginning. Their presence in this study helped to create a positive atmosphere for the whole class. It was also fortunate that most maker groups included two of these students and only one maker group had just one *Enthusiast*,

though it's possible that this was more a result of the classroom teacher's good planning skills and less about luck. Either way, it's likely that the *Enthusiasts'* open endorsement of both the maker and mindful activities impacted the way that the other students took to the program.

The Reticents

Braelyn, Carmella, Liam, and Maya

There were four students in the study who were often quiet and soft-spoken. Three of the four appeared hesitant to raise their hands in class discussions, and they could all be overlooked by peers and teachers. Maya, for example, was described as quiet and watchful (JEK Field Notes, Session 5) and Liam was described as "always quiet" (JEK Field Notes, Session 7). Indeed, it was notably out of character when Liam answered questions in front of the class (CF Field Notes, Session 4). In session one of the program, the observer noted that Carmella "had her hand slightly up but the teachers didn't see her (NPO Field Notes, Session 1) and in session two she saw that Braelyn had her hand up briefly but didn't get picked" (NPO Field Notes, Session 2).

I wrote about the latter instance in my own field notes. We had split the class into two groups, one per facilitator. We each had a set of human figures cut out of brown paper. The idea was for the students to identify where in their bodies they felt certain emotions — happiness, sadness, worry, and anger — and then instruct us on how to draw them. I had seen Braelyn raise her hand out of the corner of my eye, but the other students were much more vocal than she was, and they were jostling to be heard. Braelyn's hand was down again by the time the question had been answered by several

other students. I approached Braelyn after the activity to assure her that I'd like to know what she wanted to say. She smiled at my concern, tucked her head down, looked away, and whispered, "I forgot" (JEK Field Notes, Session 2).

This happened with her classmates as well. In one of the making sessions, a student in Liam's group announced quite loudly that she was "going to add fur" to their human cutout. Many of the students enjoyed decorating their 'buddies' with various materials but this must have struck Liam as odd. He responded, "Why would you add fur?" His voice was soft in the din created by six groups of makers at work, but it was rare for him to speak up — and therefore noticeable — and I heard his question from several paces away. Still, no one in his group responded and he didn't repeat himself (JEK Field Notes, Session 7).

The *Reticents* were often seen smiling, they exhibited a positive attitude towards the work at hand as well as their peers and, throughout the eight sessions, there was rarely a time when any of them could be considered off task. They also seemed to get along well with the others, though in Maya and Liam's case they did not seem particularly close with any of their peers. In addition to their quiet demeanor, these four participants were grouped thematically together because of the passive role they took on in the making activities, their preference for clear instructions, and their reaction to the individualized lesson on circuitry (see Appendix G).

Passive Role in Making

The busyness, high energy, and noise of the making activities were captured numerous times in field notes. "As soon as the making began" in the first session, "the noise in the room rose dramatically and there was a palpable change in the energy and level of excitement" (JEK Field Notes, Session 1). It was an energy that at times "felt chaotic" (CF Field Notes, Session 1) and "frenetic" (CF Field Notes, Session 3). It was also an energy that the class sustained at length: "The excitement in the room was palpable and that same level of energy had been maintained for nearly 40 minutes of making" (JEK Field Notes, Session 3). Within this boisterous atmosphere, it was more challenging to observe how the Reticents engaged in making than it was to gauge that of their more outgoing peers.

Over time, however, it became clear that the four students in this category generally took on a more passive role in the making. Liam was described at one point as "interested in the project but … not hands on" and "more reserved" than the other students in his maker group (CF Field Notes, Session 1). He was often seen "sitting and watching" (NPO Field Notes, Session 5) and "sitting off to one side, attentive but not really engaging with his group" (NPO Field Notes, Session 7). Maya was "content to be just watching the [making] activity rather than participating" and "definitely interested in the proceedings, just not taking a very direct role in the making" (JEK Field Notes, Session 5). By session five, I noted that Maya "seem[ed] to be in the role of an assistant" during the making activities. That is, her role was to "stand back, watch a lot, and hand

out tape" and she didn't "seem to make decisions about what to do" (JEK Field Notes, Session 5).

Sometimes, this passive role was more observable in relation to another group member, including an *Enthusiast* peer from whom they would take direction. As noted earlier, Marie was observed instructing Maya to build "whatever design you want, just make sure it's based off that" as she pointed to the neuron diagrams on the screen. When Maya then "began to add red eyes with black circles to their buddy" Marie went to the materials table for googly eyes and "glued those on instead" (NPO Field Notes, Session 3). In a similar manner, Carmella was seen as "not too engaged" (NPO Field Notes, Session 1) except when working next to Hannah (an *Enthusiast*) who pointedly instructed her to rewrite the name of their buddy in session five (CF Field Notes, Session 5) and for whom Carmella waited "so that they could make something" as if she didn't know what to do on her own (NPO Field Notes, Session 7). In Braelyn's case, it was Nadia (an *Enthusiast*) who took charge. They were often seen working side by side, but it was Nadia who took the lead by telling Braelyn how to make a hole in the buddy for the LED: "If you go from the top, you can be more precise," she said. Later, Nadia stopped Braelyn from trying to poke a hole in the cardboard with a pencil, telling her their group didn't need her to do that (NPO Field Notes, Session 7).

Preference for Instructions

The *Reticent* students' tendency to take direction from others is comparable to what was observed as an apparent preference for instructions. In both cases, *Reticent*

students seemed to prefer being guided rather than to lead. Makerspace pedagogy encourages student-led collaborative learning that requires a multitude of group decisions to be made around how to build artefacts and/or representations of knowledge. Students are free to make mistakes, learn from those mistakes, and try again. Yet there is the possibility that this relative freedom creates real discomfort for some students. After all, by the fourth grade — like the participants in this study — they are thoroughly steeped in a culture of instructions and guidelines from lining up at the door when the bell rings, to filling out worksheets and completing assignments, to following rubrics depicting achievement levels, to asking permission for access to the bathroom. Given this kind of foundation and the "transmission-based system" of schooling that discourages students from taking risks (Hughes & Morrison, 2018, p. 375), the sudden dearth of instructions in a making session can leave some "well-trained" students disoriented and wondering what to do.

In the first making session, for example, I noted that a student pointed at the brain stem on our colourful model brain and asked, "How do I make this part?" I responded, "However you want to make that part is perfectly okay." The student gave me a quizzical look but seemed satisfied and went back to his table to work (JEK Field Notes, Session 1). Like this student, most of the study participants — the *Enthusiasts* in particular — seemed to enjoy the relative freedom of making. In the *Reticent* group, however, there was a notable preference for clear instructions. During one making activity the screen at the front of the room suddenly turned off and the students were momentarily building models without access to multiple drawings of a neuron. Most

students continued to work, but Braelyn expressed concern: "Oh no!" she said, "I have no idea what to do." When the screen came back online a few moments later, she said, "Thank goodness because I had no idea what this was supposed to look like" (NPO Field Notes, Session 3).

This preference for instructions came up again in her post-program interview. When asked on which type of day ('making' or 'non-making') it was easier to pay attention, Braelyn misconstrued the question, thinking she had to pick a particular day. She answered, "It was easier to pay attention on the day when you could look at all the steps with your group and pay attention to all the steps." Confused, I asked her to explain what she meant by 'the steps'. "Like the final one for the lights when you made steps," she said. I then understood that she meant the one day (session six) when students built circuits using diagrams with step-by-step instructions to follow. This sentiment was echoed by Carmella in her post-program interview. When asked about something that stood out in the MakerMinds program, Carmella chose learning circuitry because "when we were learning it, when we got to read the steps, that was helpful to me."

According to many of the students' journals, the circuitry lesson stood out as particularly enjoyable. However, for the students in this group — who seemed to prefer instructions to complete freedom and also took on a passive role in the making — this session was a chance to 'make' something *alone.* It was also a chance to do so by following a series of steps. Although I originally planned for this lesson to be much more student-led and in keeping with makerspace pedagogy, two important and

related considerations changed my mind. First, we were pressed for time and, second, I wanted all of the students to be able to build simple electrical circuits so they could then meaningfully participate in the final making session.

Learning about Circuitry

The intention was for every student to be able to independently build a working LED so that they could all participate in the collaborative building of these LEDs into the final models (see chapter four for a full description of this session). In the allotted time of approximately 45 minutes, clear instructions and diagrams were necessary to help as many participants as possible progress from little to no understanding of electrical circuitry to the rather satisfying ability to light up an LED using a battery, some wires, and a switch. Indeed, all of the *Reticent* students were successful in this regard (as well as most of their peers). And, along the way, they had to overcome multiple minor obstacles that made their final accomplishment all the more satisfying. An excerpt from my field notes captures one of these moments:

> *I saw that Braelyn was discouraged because she couldn't get her circuit to work so I stopped to help. She simply would not move on to circuit #2 without first being able to complete #1 even though most of the class had already moved ahead. In a frustrated voice, she whispered, "I can't do this!" but the trouble was only that her LED was the wrong way around. I told her that it was often hard to tell the long leg from the short leg on the light and said she might want to check if it worked the other way around. When the little yellow bulb suddenly lit up, she looked at me with a grin on her face. She was obviously thrilled and immediately ready to do the next one. "Oh, I'll be able to do that," she said. The boy next to her said he would help and she seemed to like that offer so I left.*

(JEK Field Notes, Session 6)

Maya and Carmella were also observed "persevering" through these obstacles, each of them "determined to get their own circuits to work" (CF Field Notes, Session 6). Indeed, Maya's journal from that day reflected a certain confidence she had not expressed before. In answer to the prompt, "Tell me something you learned about yourself," Maya wrote, "I learned that I am good at doing electrical circuits" (Maya's Journal, Session 6). It was perhaps this dash of confidence that, in part, led to her notable participation in the next and final session. First, Maya "who is usually quiet, raised her hand and answered a question" during the Check-In (CF Field Notes, Session 7) but it was her behaviour during the making activity that was remarkable.

Though Maya didn't put the actual electrical circuit together, she did actively participate in deciding its colour (red) and placement (the heart) and then she drew, cut out, and pasted a paper heart where the LED would be placed on the group's 'buddy'. In field notes, I described this as "a big moment for a student who usually watches the making rather than getting in the middle of things" (JEK Field Notes, Session 7). Maya's own pride and pleasure in her role was evident in her journal: "I liked how nobody wanted to give up when our circuit wasn't working," she wrote, and then added, "I learned that I am a good helper" (Maya's Journal, Session 7).

As for Liam, in his post-program interview he chose "the day when we made electrical circuits" as his most preferred day of the entire program. Though he was not alone in his high estimation of session six, it was gratifying to observe this generally passive student actively help his group incorporate an LED into their final model (JEK Field Notes, Session 7). I had intended for all MakerMinds participants to be able to

effectively participate in building the electrical aspect of their human cutouts; however, I did not anticipate the effect this session would have on the *Reticent* students. The boost of confidence they received through the circuitry lesson seemed to be the result of suspending their maker groups for a day. By doing this, I effectively also suspended their role as passive participants in the making and gave them a chance to be in charge of it instead, albeit scaffolded with kits and instructions. It was a kind of 'maker training' that I didn't realize would be needed by some participants. This suggests that certain students would benefit from a well-scaffolded and independent lesson in making *before* they are expected to work in groups. It might even be the case that the making aspect of the program would be more inclusive if different approaches were encouraged rather than just the small-group format.

Responses to the Program

Collecting these four students under the title *Reticent* reflects, in part, the role they played in the making but it does not reflect their reaction to that making or indeed to the program overall. In fact, much like the *Enthusiasts*, the *Reticent* students were overwhelmingly positive in their reaction to MakerMinds. Their journal responses make this clear (see Appendix H). Of the four students, there was only one (Maya) who missed a single session and was unable to fill in her journal that day. In answer to the question, *What things did you like about today?* there were therefore 27 possible positive responses and this group answered positively 27 times.

In answer to the question, *What things did you __not__ like about today?* this group provided 11 negative responses but they also answered this negative prompt with an additional 16 positive responses. Some of the negative responses reflected a positive attitude toward the making sessions, as when Carmella complained that we "didn't get to work on brains" (Carmella's Journal, Session 2 and 4). Others reflected a range of negative reflections. Liam complained about getting clay in his fingernails (Liam's Journal, Session 1) while Carmella was frustrated with their model brain not working out (Session 5) and having to redo their work (Session 6). It is worth noting that none of the students in this category used their journal writing to express a negative answer to the positive question, *What things did you like about today?* This held true even though so many of them answered the negative question with a positive response.

Uptake of Mindfulness

By their journals alone, it seems that the *Reticent* students enjoyed the MakerMinds program as much as their *Enthusiast* peers. However, they differed somewhat in their uptake of the mindfulness content (see Appendix I). Whereas 85 percent of the *Enthusiasts* had adopted mindfulness tools into their everyday lives by the third session, only half of the *Reticent* students had done the same. Two of the students — Liam and Carmella — were early adopters like their *Enthusiast* peers.

As early as session two, Liam responded to the journal prompt, *Tell me about a time in the past week when you used a mindfulness tool,* by writing that he used one "to calm down". In session three, Carmella wrote that she "used the 5 senses tool when I was

mad at my brother". The other two students — Maya and Braelyn — were much more cautious in this key aspect of the program. They did not begin to use mindfulness tools on their own until the sixth week. It wasn't until Maya's sixth journal that she finally responded to this prompt with an answer other than "I forgot" or "I don't know." She then wrote, "I did square breathing with my Mom" (Maya's Journal, Session 6). Braelyn wrote, "I did square breathing and I did yoga" in that sixth week as well. Regardless of these mixed results in terms of timing, all of the *Reticent* students did end up integrating mindfulness tools into their lives outside of the program. In her post-program interview, Braelyn explained that she was putting her new skills to use:

> JEK*: What about mindfulness tools, have you been using any outside of school?*
> Braelyn*: I have. At home, sometimes when I get frustrated, I do five fingers or square breathing.*
> JEK*: Can you give me an example?*
> Braelyn*: When I got a little frustrated with my Mom because Mom was feeding me burgers and I didn't really want burgers so I went upstairs to my room and I was trying to calm myself down.*
> JEK*: How did you feel before you were calm?*
> Braelyn*: My palms were all sweaty and I was getting all tense.*
> JEK*: So then what did you do?*
> Braelyn*: I did square breathing and it really helped me.*
> JEK*: How did you feel afterwards?*
> Braelyn*: I felt all nice and calm and I went downstairs and said "Well, burgers sounds great!"*

Though minor in scale, this story indicates Braelyn's awareness of the physical manifestations of her emotions. It also shows that she learned how to use mindfulness to avoid simply reacting to a situation and, instead, to form a more appropriate response. Likewise, in Carmella's interview she explained that she uses mindfulness outside of school, "Because like when I usually get upset when my sister is rude, I

usually do the five finger breathing and it helps me calm down". Liam talked about his preference for square breathing over the other tools and using it "when I can't fall asleep or like when my brother is being mean" (Liam's Interview). Finally, Maya's mother was one of those parents who thanked me for teaching the class. She said Maya "loved it and we've seen her using it at home — the five senses tool, the five good things before bed. These are great strategies and she's really enjoyed learning about them" (JEK Field Notes, Session 8).

Conclusion

The trajectory of the *Reticent* students through this program would have been very easy to miss were it not for my use of certain research tools. The *Reticents* of this world are, after all, easy to overlook amidst the competing demands of a crowded classroom. It is cases like these that show the vital importance of including students' own voices in research. Without reflection journals and personal interviews, very little of the *Reticent* students' personal growth would have been evident, even with three researchers observing the study. This was particularly true of their experience with making, their engagement in the circuitry lesson, and their ultimate adoption of mindfulness tools. Though outwardly their engagement in this program appeared quite subtle, the *Reticents'* actual experience was just as meaningful as that of any other student in the class.

The Distracted

Jacob, Mason, and Nick

There were three participants in this study (all boys) who could best be described as *Distracted* and sometimes — in terms of their effects on others — as *Distractors*. They often disengaged from the making and other activities; they were repeatedly observed as being 'off task'; and their behaviour was seen as disruptive at times. As an experienced teacher, I was not at all surprised to witness this *Distracted* element in the classroom, but I was happy to find that it was never really problematic. Though these three boys were the least participative in the making relative to their peers, they still joined in occasionally and turned to others in their groups for direction. In fact, all three expressed their enjoyment of the program overall and the making in particular (see Appendix J).

(Relative) Lack of Engagement

This group was small in number but conspicuous in behaviour. They stood out mainly for the various ways they exhibited a lack of engagement in activities as opposed to the rest of the students who were much more consistent in their active participation. The data on Nick, for example, is dominated by descriptions of him as apparently "bored [and] off task" (CF Field Notes, Session 5), as "not engaged" and hanging around different groups (CF Field Notes, Session 7), as "completely distracted" (NPO Field Notes, Session 4), and as "rolling around in a chair" and "not [doing] much writing" (CF Field Notes, Session 4). When the rest of his group went up to the screen to

get a closer look at what they were building one day, it was Nick who stayed behind (NPO Field Notes, Session 5). Nick was described as often "assum[ing] a reclined posture during class discussions" (CF Field Notes, Session 2). On its own, that wouldn't have mattered given the relative freedom students had to make themselves comfortable. But taken together with a student who was also described as being "a little silly[9]" (NPO Field Notes, Session 6) and appearing not to participate in the contemplative exercises (NPO Field Notes, Sessions 1, 4, and 5), it helps to complete the picture of disengaged behaviour.

Similarly, Mason was seen as "less involved in the group" than the others right from the first session (CF Field Notes, Session 1). He was also observed "wandering from his group" (NPO Field Notes, Session 7) and as "not engaged and need[ing] a lot of encouragement to stay with his group" (CF Field Notes, Session 7). He was observed "being a bit silly and need[ing] a reminder from [me] to behave" (NPO Field Notes, Session 6). His typical lack of meaningful participation in the making was captured in the following field note:

> *Mason was [hanging out] with other groups and also fiddling with an electrical switch, not realizing that he could break it. He also grabbed the switch out of another group member's hand. When I asked him if he could find a more mindful way to help his group, he said 'yes' but he never really gelled with them today. And his group didn't seem to coax him back in.*
>
> (CF Field Notes, Session 7)

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[9] The term "silly" (and stemmed words) was used in relation to behaviour that also appeared off-task, clearly unproductive, or disruptive. It's worth noting that it was used twice as often in reference to the students in the "Distracted" theme than for the rest of the students combined.

This note also speaks to how his behaviour affected the way Mason was treated by his maker group. Sometimes they called him to task, like when a group member asked him, "Why are you sitting there doing nothing?" and another told him, "You didn't help me clean up at all" (NPO Field Notes, Session 3). Other times, they left him out altogether. This was evident in his post-program interview when he stated that he liked the spine best of all the making activities but he "didn't make it" because he "just couldn't touch it" (Mason's Interview).

Jacob also experienced this sense of being excluded and he wrote about it in one of his journals. In response to the question, *What things did you not like about today?* he wrote, "I didn't like the fact that people in my group didn't want me to help. I felt left out" (Jacob's Journal, Session 5). Another time, Jacob asked a group member why he wasn't allowed to put the mouth onto their buddy. The boy responded, "because I don't trust you!" (JEK Field Notes, Session 5). At the time, I thought that this was said in jest but later, after watching how often Jacob was left out of the making, I returned to that note and added that I had "misinterpreted" the moment as fun and "needed more context to understand what was actually happening" (JEK Field Notes, Session 5). To a lesser extent than both Mason and Nick, Jacob was also described as "quite distracted" (NPO Field Notes, Session 2) and his behaviour was seen as "silly" (NPO Field Notes, Session 4 and 7), "quite silly" (JEK Field Notes, Session 3), and requiring "a mindful reminder not to be silly by his homeroom teacher" (NPO Field Notes, Session 5).

Looking to Others for Guidance

Whenever these *Distracted* students did partake in the making activities, much like the *Reticent* students, they seemed to turn to others in their group for guidance. In session three, Nick was observed "looking to others for help and direction" and "openly receiving that help" (CF Field Notes, Session 3). For example, when he was cutting felt for dendrites, he checked in with other group members to see what colour he should use (CF Field Notes, Session 3). Nick was also the student whom Cam (an *Enthusiast*) encouraged to help with the making. As mentioned earlier, Cam took it upon himself to be a leader in his maker group. After the first session, Cam wrote, "We could have fooled around less" and "I have to step up and be a leader" (Cam's Journal, Session 1). Based on Cam's behaviour in the next making session, during which he was observed offering "encouraging words" to Nick in particular, it seems clear that Nick's distracted behaviour was the main source of his concern. And Nick, in the end, expressed some appreciation for this help. He said, "I didn't always know what to build and some people in our group helped me by giving me ideas of what I should do" (Nick's Interview).

Mason's behaviour was similar in that he was often seen physically manipulating materials for making but there was little evidence of any genuine contribution to the final product. That is, he was seen "fiddling with the yarn, not making really, but engaging with his group socially" (CF Field Notes, Session 3). He was seen "playing with toothpicks and a paintbrush but not making after a while" (CF Field Notes, Session 5). And his classroom teacher stopped to ask him what he was doing during one session

because he "didn't seem to be contributing much" (NPO Field Notes, Session 5). That's not to say he didn't try. By his own admission, he "didn't really know what to do and then they [his fellow group members] told me what to do" (Mason's Interview). In session three, he turned to Ethan for direction because "the cutting task he was working on was challenging and he was trying to work out how to move forward [so he] asked for help" (CF Field Notes, Session 3). And when he put some "soft blue squishy material" onto their buddy, he asked another peer if it was okay before placing it down (NPO Field Notes, Session 5). He was also observed "adding random fluff to the buddy while beatboxing" before suddenly asking Nadia, "How can I help you?" When Nadia replied with a rather vague direction "to decorate the buddy," Mason grabbed some string, "put it around his waist and head and wandered slowly back to his group" (NPO Field Notes, Session 7).

To a lesser extent, this behaviour was noted in Jacob who was observed rubbing two sheets of glittery paper together so that the glitter rained down onto their buddy. When one of his group mates saw this, Jacob was told to "stop glittering" because "we need to be serious" (NPO Field Notes, Session 7). Repeatedly, Jacob was discouraged from adding elements to the human cutout and he seemed to understand that he needed permission to participate. In one session, he turned to an *Enthusiast* in his group for affirmation while decorating their buddy, asking, "He doesn't look too bad, right?" (NPO Field Notes, Session 5). It was never fully clear, however, if Jacob's ideas were excluded because of his often 'silly' behaviour or if that behaviour was partly a reaction to being excluded from the making. Unlike the other two *Distracted* students, Jacob was

observed excitedly introducing an idea of his own. In session three, Jacob called out to me as I passed by, "That's an axon," pointing at what another boy was working on. Then he shouted to his peer, "Let's use pink paint for that… no wait, pink clay!" At the time, he was also wearing a lei from the materials table around his neck and pretending to hula which might have undermined the seriousness of his suggestion. In the end, there was no evidence of a pink axon to be found in photographs of this group's final model.

Responses to the Program

Relative to the other participants in this study, the *Distracted* students did not contribute significantly to their final products. Despite this, all three boys in this group expressed their enjoyment of the making sessions and the program overall. When Nick's mother attended the open house, he pointed to each part in turn, saying "buddy, Fred, neurons, [and] spinal cord" and then told her, "I also made these, those, the hair, and the labelling" indicating various parts of the body (NPO Field Notes, Session 8). Indeed, Nick was observed helping Cam to add labels and glue on nerves in the final making session (NPO Field Notes, Session 8). And, in his post-program interview, he had this to say:

> *I liked how we got to really build and learn about the body, how we got to actually construct a brain, neurons, all the different kinds of stuff. And we learned how to, like, actually know what is happening in your brain when sometimes people don't know, but you know what's happening in your brain. That's what stands out.*
>
> <div align="right">(Nick's Interview)</div>

Though Mason didn't express his enjoyment quite so directly, his mother's post-program interview made his enthusiasm clear. She explained,

> *I am so impressed by the understanding [Mason] has of the neuron and the nervous system and how it all works. This is the deepest level of science learning that I have yet seen in my son. And we're seeing it at home as well. He doesn't usually tell us too much about school but we are hearing all about this. I'm just so impressed.*

<div align="right">(Parental Interview for Mason)</div>

Finally, Jacob's overall reaction to the program could be seen in the way that he and another boy from his group proudly "sat with their buddy through the whole open house and were continually excited to show off the working circuit" and also how he "excitedly and repeatedly" explained large portions of the program contents to various guests in a way that revealed how much he had learned over the previous seven sessions (JEK Field Notes, Session 8).

All three boys also indicated their positive reaction to the program in their journal responses (see Appendix K). Two of the boys (Mason and Nick) were each absent on one day. Excluding these absences, there were 19 possible positive responses to the question, *What things did you like about today?* This group responded with 19 positive answers. To the negative question, they responded with only four negative answers, two of which were about wanting to make up their own groups and one of which — possibly the most serious — was Jacob's dislike of being left out. In addition, this group added another 12 positive answers to this negative prompt.

Uptake of Mindfulness

In the end, all three members of this group/theme responded positively to MakerMinds. This included the mindfulness pedagogy, though to varying degrees (see Appendix L). Of the three, Nick seemed the least interested in carrying out any of the contemplative practices conducted together in class and, when asked what he had learned about mindfulness in the program, his answer was confusing. He said, "So freeze, you're going to calm down and breathe, stay there, and then also five good things before bed, also mindfulness" (Nick's Interview). Still, he wrote in his journal about using the mindfulness tools outside of the program. In the fifth session, he wrote that he used "5 things before bed" and then in the sixth session that he "used it when I was mad at my house at my sister."

Mason, on the other hand, clearly enjoyed participating in the mindfulness portion of the program. In one session, he carried out the meditation with "his eyes closed throughout and presenting a very calm demeanor" while others around him were "moving between attending and not attending" (JEK Field Notes, Session 5). He also "let out a nice deep breath" after one mindful exercise (NPO Field Notes, Session 1) and got up from another saying, "I feel very calm" (NPO Field Notes, Session 2). Most importantly, Mason's journal writing revealed that he was learning to see himself as someone who "can focus on some activities" and "make myself focus" (Mason's Journals, Session 1 and 2). However, it wasn't until the sixth session that he indicated his use of a mindfulness tool outside of the program "to do my homework in the class about five finger breathing" as if he was simply doing his homework rather than

putting a tool to any real use. Once again, it was Mason's mother who clarified her son's enthusiasm. She had witnessed Mason using various tools — including full belly breathing, five senses, and square breathing — on three different occasions outside of school and he had also tried to teach her to use one of them (Mason's Parental Interview).

Of the three boys, though, it was Jacob who showed the most growth in terms of mindfulness. He had "never used mindfulness before" the program and "it was a bit new" to him (Jacob's Interview), but by session three he was regularly using mindfulness tools outside of class. He wrote, "I breath [sic] in and out when my brother made fun of me" (Jacob's Journal, Session 3) and then he filled in this section of his journal each week with a variety of tools, including square breathing, five good things before bed, and full-belly breathing. It was his post-program interview, however, that was most revealing, particularly the following exchange about how learning mindfulness helped him:

> Jacob: *Well, I learn to be patient in making, like puzzles for example. Like I had this egg puzzle that was a 3D one and it kept falling apart and I actually did some mindfulness to help me get through it.*
> JEK: *This is recently then?*
> Jacob: *Yeah.*
> JEK: *So what did you use?*
> Jacob: *I did some square breathing and also the five senses.*
> JEK: *And did it make a difference? Did it help?*
> Jacob: *Yeah, it helped.*
> JEK: *Were you able to continue or did you give up?*
> Jacob: *The first time when I started building it, I hadn't come to MakerMinds yet and it kind of was more angry and wanted to give up and once I actually gave up, but then when I learned these mindfulness tools, I never gave up again.*

Not only was Jacob finding ways to use mindfulness tools in his daily life, he was also teaching his mother to use square breathing and he regularly incorporated mindfulness into his bedtime routine (Jacob's Interview).

Conclusion

Of these three *Distracted* students, then, two did very well in terms of the program's key goal of embedding mindfulness practices into students' daily lives, and the third suggested that he was indeed using these tools occasionally. It was somewhat surprising to see that this group responded positively to the mindfulness pedagogy in the end, but perhaps it shouldn't have been. Though these students caused some minor disturbances throughout the program and were often disengaged from the making and from their maker groups, it is perhaps a testament to the combination of the two pedagogies that they still enjoyed themselves and learned far more than their behaviour implied.

The Builders

Ethan, Joseph, and Michael

The fourth and final group consists of three boys — the *Builders* — whose enthusiasm for the making activities far outweighed any interest they expressed in mindfulness pedagogy. For these three apparently earnest students — Ethan, Joseph, and Michael — the makerspace pedagogy seemed to capture and hold their attention through eight weeks of programming, while the circuitry gave them a particular place to shine within their maker groups. Also, despite their apparent lack of interest in

mindfulness, by the end, all three had incorporated mindfulness tools into their lives to some extent (see Appendix M).

Verbal Participation and Distracted Behaviour

In comparison to many of the other students, the *Builders* were quiet, yet not as quiet as those in the *Reticent* category. Ethan was perhaps the most outspoken. Far more often than the others, Ethan raised his hand to ask or answer questions and add to class discussions. Joseph was definitely the quietest, but we still heard from him a few times outside of his maker group. And Michael fell somewhere in between the other two. He contributed to small group discussions and spoke up in front of the whole class two or three times. At the same time, though they were generally well-behaved and on task, these students did occasionally become distracted. Michael and Joseph, for example, "needed a reminder to stop being silly" in session six (NPO Field Notes, Session 6) and Ethan was asked to move closer to the teacher because he was "being a bit silly and off task" in session seven (NPO Field Notes, Session 7). Another time, Michael was "asked to stop fooling around and make better choices" (NPO Field Notes, Session 2) and both Michael and Ethan were laughing and "trying to hum in each other's ears" during one of the contemplative practices (NPO Field Notes, Session 5). Unlike the *Distracted* students, however, this occasional silliness did not detract from their productivity or their engagement in making.

Uptake of Mindfulness

Though all of the students in this study expressed a preference for the 'making' days over the 'non-making' days (see chapter six), for the *Builders* this distinction seemed to be most acute. That is, the students in this category were consistently enthusiastic about making throughout the program, but unenthusiastic about mindfulness. This continued until late in the program when the *Builders'* acceptance of mindful practices seemed to improve slightly.

Based on his journal responses, Joseph was the most obviously disinterested participant. Following session one he wrote, "I did not like all the stretches and stuff we did at the beginning of the period." At the end of session two he wrote "I did not like when we do those poses." In session four he "did not like the meditations" and in session six he clarified that he "did not like the stretching in the start because I would rather like to do the activities more than the stretches." No observational evidence was recorded to indicate Joseph's distaste for the contemplative practices, which suggests that he participated in each of these activities without issue. However, like the other *Builders*, Joseph was a late adopter of mindfulness tools. It wasn't until the sixth session that he indicated his use of square breathing when his brother didn't let him play on their Xbox (Joseph's Journal, Session 6). In the seventh session, he said that he had used finger breathing for the same reason (Joseph's Journal, Session 7).

Ethan's journals were less revealing than Joseph's, but on the one 'non-making' day he experienced (he was absent for the other one), he responded to the positive prompt, *What things did you like about today?* with the negative answer, "Nothing much

really" (Ethan's Journal, Session 4). This answer stood out for two reasons. First, he did in fact have positive things to say about all of the other sessions. Second, this was one of only two such reversals in all of the students' journal responses, and it was the only one that was actually negative[10].

Beyond this, Ethan's interview suggested he was non-committal in his adoption of mindfulness. When asked if he was using any mindfulness tools outside of school, Ethan answered, "a few times when my brother gets mad at me for no reason" which he clarified to mean, "I just try to ignore him." Understandably, Ethan didn't want to make any of the accompanying gestures in front of his brother for fear of being teased. When asked if he would be using any of these tools in the future, Ethan responded, "Maybe." Even so, Ethan wrote about using the mindfulness tools on his own three times, though not until late in the program. In session five he wrote about using mindfulness "to calm down when I couldn't decide on something"; in session six he wrote about using "full stomach breathing to get more relaxed at my house"; and in session seven he wrote that mindfulness calmed him down when he was worried (Ethan's Journals, Sessions 5, 6, and 7).

Michael, on the other hand, was more effusive in his praise of the mindful practices we learned. In his interview he said, "I love how we … did a lot of meditation, which helps me, especially before tests and stuff." However, like the others in this

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[10] The other negative response to a positive prompt was written in the sixth session by a student who professed to enjoy the lesson but wanted to make it clear that he already knew all about electrical circuitry (Max's Journal, Session 6).

category, Michael was a late adopter of the mindfulness tools. He wrote about them only once and this was not until session six (Michael's Journal, Session 6).

Enthusiastic Makers

Like the title of this category implies, all three of the *Builders* embraced the makerspace pedagogy right from the start of the program and they made their enthusiasm clear. Ethan "wanted everyone to correctly shape the parts of the brain that they were working on" (NPO Field Notes, Session 1) and was "really eager to start making" (CF Field Notes, Session 5). He also had "very specific ideas of how he wanted [his group's] neuron to look" (CF Field Notes, Session 3). In session five, Ethan "grabbed the materials for the spine" from a jar on the materials table and "said 'Yaaaah' excitedly while looking at [the observer]" (NPO Field Notes, Session 5). Michael was observed "making the blue part of the brain" and repeatedly going up to the screen "to get the shape correct" (NPO Field Notes, Session 1). He also spent a lot of time attempting to decorate the face of his group's buddy (JEK Field Notes, Session 5) and was a key figure in integrating the electrical circuits (JEK Field Notes, Session 7). Similarly, Joseph began the first making session "fully fixated on achieving the exact colours of the clay as the model brain" and kept "combining colours to get it just right" (CF Field Notes, Session 1). In the next making session, he asked to see the model brain again so that he could continue to work on perfecting the shape and design of the one his group was working on (CF Field Notes, Session 3).

The *Builders'* enthusiasm for making was unmistakable, but their ability to enact that enthusiasm was impacted by their maker groups to varying degrees. Ethan's group seemed to appreciate his eager participation and skills so he contributed freely to their final model. One of his group mates said that working with him "was actually really helpful because [he] knew how to put the pieces together … and he's good at art" (Nadia's Interview). As mentioned earlier, however, Michael's ability to participate in the making was hampered somewhat by another group member (an *Enthusiast*) who refused to let him add a moustache or a unibrow to their buddy's face (JEK Field Notes, Session 5). He also seemed to be left out at times like when he stayed at the table "while his team members went to pick out the materials" (NPO Field Notes, Session 5). Likewise, Joseph's participation was inhibited to some extent by the presence of a certain *Distracted* student whose "messing around" was disruptive (Joseph's Interview). When Joseph reached for the circuitry kit, this same student grabbed it away from him and said, "No, I'm opening it" (NPO Field Notes, Session 7). Also, it was Joseph's rendering of the name "Fred" that was dismissed as inadequate by an *Enthusiast* in his group and then rewritten.

Learning about Circuitry

Perhaps because they had been pushed aside to some extent, the circuitry aspect of making seemed to be particularly gratifying for Michael and Joseph. It was in this realm that the *Builders* (including Ethan) took on a leadership role within their maker groups. This was most evident in Michael's case. Several of the boys in this all-boys

group struggled together to light up their buddy's amygdala with a yellow LED

attached to a switch. This event is best described in my field notes:

> *Michael came running over to pull my attention towards their table. "Mrs. K, come look!*
> *Look at what we did!" he shouted. They had a working switch and LED in the amygdala*
> *but as soon as they showed it to me, it went out. "Nooo!" several boys moaned at the*
> *same time. Michael got down on his hands and knees and crawled underneath the*
> *cardboard to get a closer look. He was with two of the other boys, Isaac and Tyler. They*
> *kept trying the switch but the light wouldn't come on. With plenty of time left in the*
> *session, I suggested that they take it apart and try again. A few minutes later, after*
> *removing the tape and pulling it apart, Michael said, "It's not the battery. Look! The*
> *wires are barely touching." They reattached everything and, after a few more minutes of*
> *work, they tested the light again. It still didn't go on. They were frustrated, but I left*
> *them to it.*

This excerpt provides some sense of how challenging it was to connect the electrical

circuits properly. It also shows how Michael began to take on a central role in getting

his group's circuit to work. Soon after I recorded this event, I heard Michael call out,

"Let's test it first guys, we have to test it before we do it!" (JEK Field Notes, Session 7). It

sounded to me as if he was taking charge. Towards the end of this making session, I

recorded the following note:

> *At one point, the light went on and they all shouted, "Hurray!" and then it immediately*
> *went out again. I listened to their conversation as they tried to figure out what was*
> *wrong. One boy said, "Why is it coming off?" Another said, "Oh wait, that red wire is*
> *falling off completely" and Tyler directed, "Check that one wire from there to there."*
> *Michael suddenly said, "This wire has only one piece in it!" Then he showed it to me and*
> *I saw what he meant. The wire they were working with needed to be restripped on one*
> *end. I showed Michael how to do this and then the boys set back to work. Finally, I heard*
> *Michael shout, "Yes, we've done it! We've done it!" and their light was indeed working.*

Very quickly, Michael moved from the periphery of his maker group, where he wasn't

allowed to add the decorations he wanted, to the centre of the group where he was the

person who figured out what was wrong with their circuit. After this, the other boys left

Michael in charge of the circuitry. Tyler (an *Enthusiast*), who had earlier written a

journal response about disliking Michael's "goofing off", spoke in his interview about how "it was really good to be working in a group because Michael really pulled his weight" (Tyler's Interview). Jacob also began referring to Michael as "the electrician" and "the electrical guy" as he maintained that finicky circuit throughout the open house. In fact, it fell apart so often that I sensed he and Jacob were breaking it on purpose just so that Michael could fix it again (JEK Field Notes, Session 8).

Joseph's experience with the circuitry was somewhat less dramatic but still gratifying. Of the five students in his maker group, Joseph was the quickest at figuring out how to put the circuits together in session six. This put him in a position of being able to share his knowledge with others. When the co-facilitator asked his group whether their switches closed or opened the circuit, it was Joseph who quickly answered the question and "he seemed so happy that he had figured it out" (CF Field Notes, Session 6). Throughout session seven, Joseph concentrated on adding circuits to his group's buddy while the others either assisted him or worked on other parts. He was observed "working on getting their circuit ready" and "trying to set up their red button" and finally "working on *another* circuit" (NPO Field Notes, Session 7, emphasis added). Indeed, Joseph's group was one of only two that managed to set up two circuits, one in the amygdala and another in the hand. At the open house, Joseph — like Michael — was in charge of keeping these circuits working. Unfortunately, one of his group's switches was an NC switch (meaning 'normally closed'). Theirs was the only group to have one of these and I had failed to explain how it worked differently from the other NO (normally open) ones. By the time this came to my attention, Joseph had

been working on this problem for a full 20 minutes. If he left the circuit connected, the NC switch would leave the LED on all the time and quickly drain their battery. To avoid this, he figured out that he could keep the heavily taped circuit intact and turn the LED itself into the switch by leaving one of the leads slightly disconnected on top of the cardboard. Guests could then move the lead to the wire and turn on the LED. Joseph "proudly showed me how [this] worked and I high-fived him while he grinned up at me" (JEK Field Notes, Session 8). In their post-program interviews, two of his group-mates reflected on Joseph's role. Hayleigh (an *Enthusiast*) felt like she didn't get a real chance to add the electrical circuits because Joseph "handled the lights" but also noted that they kept breaking and Joseph kept getting them to work again (Hayleigh's interview). Nick (a *Distracted* student) was more appreciative. He said that it was helpful to work in a group because "some stuff like the LEDs for example… using things like that, Joseph really did know what to do so that helped" (Nick's Interview).

Like Michael and Joseph, Ethan also took the lead in the circuitry aspect of the making, though this did not represent an elevation of status within his maker group. It did perhaps give him a chance to shine amongst all of his classmates. From the beginning of session six, it was clear that Ethan was happy to be working with electricity. Like the other *Builders* he was the first of his maker group to figure out how the circuits worked but he was also "the first one [in the class] to complete a circuit and he was extremely excited about it" (JEK Field Notes, Session 6). He was soon sharing his knowledge with others. At one point in that lesson, I asked the class what they had learned and "this prompted a long explanation from an excited Ethan who was trying

to show everyone that the light flickered if you didn't hold it right because the circuit needed to be closed to work" (JEK Field Notes, Session 6). I also noted that Ethan was sitting next to Braelyn (a *Reticent* student) and "was very good about working with her to make sure that she could do it [complete a circuit] as well" (JEK Field Notes, Session 6). In session seven, Ethan was "determined to get his switches working" (CF Field Notes, Session 7). His group was the first one to integrate a functioning LED into their buddy and the only group that managed to complete two such circuits that day (JEK Field Notes, Session 7). He and his group-mates "were excited and engaged" throughout this final making session (CF Field Notes, Session 7).

Responses to the Program

Given their mixed reactions to the two pedagogies in MakerMinds, it is not surprising that, according to their journal responses, the *Builders* were more mixed in their reactions than other groups (see Appendix N). Excluding their three absences (Ethan was away twice and Michael was away once), there were 18 possible positive responses to the prompt, *What things did you like about today?* The *Builders* provided 17 positive responses. However, by including the positive responses they wrote to the negative prompt, this number goes up to 28, very much in line with the other groups.

In terms of negative responses to the negative prompt, *What things did you not like about today?* the *Builders* provided 7 answers, several of which were about Joseph's distaste for mindfulness practices. Ethan, however, also added that "We didn't get to do our own bodies because I wanted my own brain" and that "another group copied us"

(Ethan's Journals, Sessions 1 and 5). As noted earlier, Ethan also included a negative

answer to the positive prompt. Including this answer, there were 8 negative responses

out of a possible 18, which is the highest percentage of negative response of all the

categories.

Beyond the journals, their reactions to the overall program were also somewhat

mixed. Michael was the most forthcoming in his appreciation of MakerMinds. He said,

"It was really fun and I enjoyed seeing the different parts of the brain and what

happens when I get frustrated and I learned about the amygdala. I never knew I had an

amygdala!" (Michael's Interview). When asked if there was anything else he wanted to

share, he said, "I liked everything really. I never really disliked anything about it. I

found it really fun and it shows people how to become less stressed and stuff especially

before things that are hard, how to calm yourself down instead of just reacting"

(Michael's Interview). Indeed, Michael's journal responses were entirely positive,

meaning he provided 12 positive responses where only 6 were expected. Joseph, on the

other hand, was much less effusive in his praise. He said that he "enjoyed making our

buddies and learning all about the brain" and that out of everything he "enjoyed

making the lights" the best (Joseph's Interview). He was also clearest in his dislike of

the mindfulness aspects of the program and provided four negative prompts out of a

possible seven. Of the three *Builders*, however, it was Ethan whose reaction to

MakerMinds could best be described as lukewarm. He provided four positive and one

negative response out of a possible five positive answers, and then added a further

three negative responses out of a possible five negative answers. When asked if there

was anything about the program that stood out in his memory, Ethan responded, "I liked the building stuff" and "the battery, LED light thing was pretty cool" (Ethan's Interview).

Conclusion

Though the three *Builders*' reactions to the overall program differed somewhat, all three were consistently and overtly positive towards the making and all three, to varying degrees, eventually expressed some openness towards mindfulness as well (see Appendix O). Perhaps it was their excitement about making that helped to sustain them through the mindfulness aspects they considered so much less interesting. Perhaps the making even ignited some interest in mindfulness, if only through the act of building the related anatomy. Either way, it was clearly the makerspace pedagogy that was the key to their positive engagement in the program. Finally, all three *Builders* enjoyed the chance to shine amongst their peers with their skillful handling of the electrical circuitry. Though not necessarily connected to mindfulness, this experience alone would have been worthwhile in terms of its potential for building confidence.

Group Dynamics

In the introduction to this chapter, I mentioned the permeable boundaries amongst the four thematic categories. Indeed, there were some students whose placement was a point of discussion between myself and my co-facilitator because they fit near the boundary between two themes. For these students, careful consideration of

the evidence eventually led to their placement. Others were the absolute embodiment of a particular theme and they were easy to place. For those students at the boundaries, however, it often seemed that their maker group-mates had an impact on where they landed. Identity theory tells us to expect this. Stets and Burke (2000) state that "the core of the identity is the categorization of the self as an occupant of a role" (p. 225) and that this role is negotiated through the different perspectives of people who are also performing their own roles within a group (p. 228).

Jacob is a prime example. He was one of the *Distracted* students but careful consideration of the criteria for the *Builders* and the *Enthusiasts* shows that he comes close to belonging to either of these two groups. Indeed, Jacob was enthusiastic about both the making and the mindfulness throughout the program and was also an early adopter of the mindfulness tools — suggesting he might be an *Enthusiast*. However, there was no evidence of the different modes of leadership exhibited in the program (including confidence, bossiness, or controlling behaviour) that would have made him fit well with the other *Enthusiasts.* Instead, Jacob — like some of the *Builders* — was sometimes distracted and also inhibited in his work by the others in his group. Also, a telling piece of evidence for Jacob's role as a *Builder* arose during his interview when he said, "I really like building that stuff and I pretty much do this stuff every day. I always ask my Mum for Lego and puzzles and that and I really like making stuff." Unlike the other *Builders*, however, he was not a late adopter of the mindfulness tools and he was actually interested in the mindfulness pedagogy from the start.

In the end, Jacob's repeatedly off-task behaviour, often described as 'silly' by the researchers, meant that he fit best with the other *Distracted* students. But what if his group had included him more in the making? What if he had been grouped with students who let him run with his ideas rather than pushing them aside? Recall that Jacob was the student who wrote, "I didn't like the fact that people in my group didn't want me to help. I felt left out" (Jacob's Journal, Session 5). Perhaps if Jacob had been more included, he would have been more focused on the work at hand and less distracting to others. In that case, he might have been more of a leader in the group and therefore more like the other *Enthusiasts*. Or, perhaps his "silliness" would have been considered playful but still productive, like the other *Builders.*

Burke and Reitzes (1981) claim that in "role relevant situations, others respond to [a] person as a performer in a particular role" and that "the meanings of the self are learned from responses of others to one's own actions" (p. 84). That is, in negotiating his role within maker group B, Jacob's identity was shaped in part by the way his group-mates responded to him. Their expectations formed a set of standards that guided his behaviour (Burke, 2009; Burke and Reitzes, 1981; Stets and Burke, 2000). In addition to several other students who fit near boundaries in this typology (i.e., *Michael, Braelyn, Max, and Noelle*), I have alluded to group members shaping the roles of their peers a number of times in this chapter. First, I suggested that having two *Enthusiasts* in almost every maker group might have had a positive impact on the way other students responded to the program. Second, the way that *Reticent* students like Braelyn and Carmella seemed to pair up with (and defer to) certain *Enthusiasts* like Nadia and

Hannah speaks to the role identities functioning within each maker group. Finally, the way that Michael and Joseph (both *Builders*) altered others' expectations of them based on their prowess with circuitry is indicative of the way that these roles can be negotiated and renegotiated.

There's no way of knowing if a different set of peers would have landed Jacob in a different category, but the notion that group composition might have impacted the role he played reinforces the very important idea that each student's assignment in this typology was situationally dependent. Jacob was not *Distracted* per se; rather his experience in group B in this particular version of the program was that of a *Distracted* student. And the same must be said of every other participant. That is, the thematic categories discussed in this chapter were in no way meant to produce a monolithic account of student participants. Instead, this was my careful and nuanced attempt to produce an account of the data.

Conclusion

In this chapter, I have attempted to share with you 'how the program went' by leveraging the rich descriptions and nuanced understandings produced by ethnographically informed research. In doing so, I have presented four thematic groups of student-experiences in the study along with some sense of the blurring of boundaries between them. No one program can be expected to achieve the same results with every participant, nor will it interest every participant to the same degree or in the same way. However, based on observational data and student reflection journals, MakerMinds

was very successful in terms of engaging the vast majority of its students in making and in getting them to use mindfulness tools on their own, a key goal of the program. All of this suggests that MakerMinds reached different students differently and to varying degrees, but it still managed to reach them. Whether their experience was that of an *Enthusiast*, a *Reticent* student, a *Distracted* student, or a *Builder,* every participant in this study explored the potential benefits of mindfulness practices and reflected positively upon the program.

Chapter Six: Discussion

Making and Mindfulness Combined

The previous chapter provided a thorough depiction of four broad themes of student experiences with MakerMinds, along with their overwhelmingly positive response to the program as a whole. In this chapter, I further explore student experiences as they relate to two key aspects of the program's structure. First, I briefly discuss student feedback on the program's comparative format of 'making' versus 'non-making' days. Second — and most importantly — I discuss findings related to the interaction of the program's combined mindfulness and makerspace pedagogies. Where possible, I connect these findings to related literature. As in the previous chapter, findings are rooted in students' own words as I rely heavily upon their reflection journals, post-program interviews, and speech captured in class, along with the observations of three researchers and both teacher and parent interviews.

Making versus Non-Making Days

Originally, the structure of MakerMinds was designed to present students with an almost equal number of 'making' and 'non-making' days. Out of the eight classes allotted to the program, I intended four to include making, three to be mindfulness-only, and one final class to hold an open house. In the end, however, four of the eight sessions were 'making' days and only two were 'non-making' days. What was to be the third 'non-making' session (session six) was reconfigured to teach students how to

build simple electrical circuits. Other than this unique session and the final open house,

all of the days were structured similarly (see chapter four for a full description). As

stated previously, the 'making' days were scheduled as double periods so that the

students spent the second half of these sessions building models of what they had

learned in the Core Content portion of that day. Though the different types of classes

weren't equal in number, students had enough experience of both to offer feedback on

which type they preferred. Knowing that students might try to provide my co-facilitator

or me with 'desirable' answers, I was careful to frame this question as neutrally as

possible. I also mitigated any potential response bias by triangulating interview data

with data from the field notes of three researchers as well as student reflection journals.

In the post-program interviews, I therefore asked the following:

> *We had two different kinds of days in the past eight weeks. On some days, we learned about mindfulness. On other days, we learned about mindfulness and we also made models. Some students preferred the 'making' days and some preferred the 'non-making' days. Which day did you prefer? Why?*

As noted in the previous chapter, both types of days were popular with most students;

however, there was a decided preference for the 'making' days. Of the 24 student-

participants, 19 agreed to a post-program interview and 17 of these students preferred

the 'making' days over the 'non-making' days. Their reasons varied, but they were

mainly related to having fun while being creative. Liam, for example, "preferred the

days when we were making because it was really fun and stuff" (Liam's Interview);

Ethan's preference for the 'making' days was rooted in his passion for "arts and crafts"

and because "this was kind of a free period to do stuff like that" (Ethan's Interview);

and Noelle noted that "when I make things I feel happy" (Noelle's Interview).

Tellingly, several students continued to 'make' right up until the last possible moment, even during the open house (JEK Field Notes, Session 8). One student, Carmella, ran past me with some materials from the nearby 'Make a Neuron' station, shouting "I'm still going to make something." Others were caught up in decorating their 'buddies' with lips, a mini brain, and lots of glitter (JEK Field Notes, Session 8). These reactions are in keeping with makerspace scholars who claim that the "simple joy of making something" can be like a "hook that brings people together" (Taylor et al., 2016, pp. 7-8) and that maker projects contribute to happiness because they involve "meaningful connections with others … and meaningful things to do" (Gauntlett, 2011, p. 126). Braelyn touched on these 'meaningful connections' when she claimed that she "liked 'making' days better because [she] liked creating things with the group" (Braelyn's Interview) while Michael wrote that he liked making because "it was fun working with friends" (Michael's Journal, Session 1). Finally, the project's relevance to the students as a 'meaningful thing to do' was indicated quite clearly at the end of the program when the teacher held a lottery because so many young makers wanted to take one of the six completed 'buddies' home.

Non-Making and Learning More

On the other hand, there were two students who preferred the 'non-making' days over the 'making' days, both of whom linked that preference to their belief that they learned more about mindfulness on those days (Cam and Esther's Interviews). Notably, a majority of the students said the same thing. When asked the follow-up

question, *On which of these types of days did you learn the most?* 12 of the 19 students answered that they learned the most on the 'non-making' days. Given the students' general enthusiasm for the making aspects of this program, this result was somewhat surprising. What was it about the 'non-making' days that convinced 63 percent of these students that they learned more when they weren't making?

For some students it was the prospect of making something later in the session that they believe distracted them from the content they were meant to learn. Hannah, for example, said that she was able to pay more attention to what we were talking about in the core content of the 'non-making' days because she "really wanted to just get to the making on the 'making' days" (Hannah's Interview). Likewise, Isaac found that he "was just thinking ahead to when we were gonna be building and [he] wasn't thinking about what we were doing and wasn't listening well" on the 'making' days (Isaac's Interview). Braelyn, on the other hand, believed that she learned more during the core content of the 'non-making' days because these were devoted entirely to mindfulness while "the 'making' days took out more of the mindfulness that you could have taught" (Braelyn's Interview). Braelyn's perspective erroneously assumes that I cut down on mindfulness content to fit in the making aspect of the program, a notion echoed by Stefie who believed she would have "learned a little bit more" if the program was mindfulness-only. However, Stefie also "liked the making classes," and felt like "if we had learned any more [about mindfulness] I would have just forget [sic] what I learned before" (Stefie's Interview).

Having Fun and Learning Less

Stefie's version of 'learning more' echoes writings of Ranciere discussed in the literature review. Ranciere (1991) claims that "the child who is *explained to* will devote [her] intelligence to … understanding that [she] doesn't understand unless [she] is explained to (p. 8). Stefie clearly believed in the transmission of knowledge from master to student (Ranciere, 1991), and that "learning" meant listening to teacher-delivered content she knew she would not necessarily process or remember. Indeed, none of these perspectives considers that learning might take place *through* making.

These students learned about several important aspects of mindfulness-related physiology and put that knowledge to work by using mindfulness tools when needed. They were in fact countering Dewey's "great waste in … school" by using what they learned in their daily lives (Dewey, 2001, p. 46). They built models of how mindfulness works and explained them to peers, teachers, and parents. And they learned/built this knowledge through twice as many making as 'non-making' sessions. Despite this, making was seen by a majority of these students as the fun part of the program they got to do *after* they did some learning of core content. Consider this exchange from Joseph's interview:

> *JEK: And which day do you think you learned more about mindfulness or the way that the body or the brain works?*
> *Joseph: Ummm. the day that we didn't do the making.*
> *JEK: Why do you think that?*
> *Joseph: Because we were focused on the brain parts.*
> *JEK: Why were you not focused on the brain parts when you were doing the making?*
> *Joseph: Because like umm, I was having fun making things.*
> *JEK: Even when we were standing at the front talking in front of the screen? What happened then?*

> *Joseph: It was harder to pay attention.*
> *JEK: Why do you think that was?*
> *Joseph: Because I just really enjoyed making stuff.*

For Joseph, the "fun" of making indicated a lack of learning, as if the two could not go hand in hand. And, like Hannah and Isaac, Joseph didn't feel able to pay full attention to the core content on 'making' days because he was distracted by the fun he would have once the making began.

There were a few students who recognized a connection between learning and making. Noelle noted that "it was a little more helpful to do the making instead of just sitting and listening to [the lessons]" (Noelle's Interview); Esther said that the making helped her to "learn the lobes and the names of everything" (Esther's Interview); and Jacob said that "making things helped me learn a bit" because he "learned to be patient in making" (Jacob's Interview). This latter example suggests that Jacob was learning mindfulness experientially through the process of overcoming inherent challenges of making, something we will consider in more detail below. Finally, Isaac said that building things meant "we could make what we thought in our heads of what we were learning" and he found this helpful because he "would have a better visual of what we were learning about" (Isaac's Interview).

Even though these students could articulate how making helped them to learn, three of the four maintained that they learned more on the 'non-making' days. For them, and for the nine other students who agreed, the concept of learning was quite strictly associated with time spent listening to their teachers. This perspective perhaps offers a glimpse of what happens when the vast majority of a student's learning takes

place through the same teacher-led format. The more time they spent sitting quietly and listening, the more they believe they "learned" regardless of whether or not the content made sense to them or how much of it was remembered. As referenced in the literature review, these students had embraced what Illich called the principal lesson of School, that they "need to be taught" (cited in Papert, 1993, p. 141) and the teacher-led "chalk and talk" — simply because it is standard across the education system — is the one format the students trusted to work.

Making and Mindfulness Combined

So what was really happening in those making sessions? How was this aspect of the program more than simply a 'fun' means of keeping students engaged in the mindfulness lessons? Did they learn about mindfulness by building representations of its related physiology, for example? These questions speak to the combination of pedagogies at the heart of this dissertation. For the rest of this chapter, I will therefore focus on findings related to that combination, rooted in evidence from multiple sources including student, parent, and teacher interviews; the observations of three researchers; and student reflection journals.

Learning Mindfulness Through Making

In contrast to traditional mindfulness training programs — and indeed traditional forms of schooling — having students *make* physical representations of their understanding leveraged the power of a constructionist approach to learning. Constructionist theorists Papert and Harel (1991) refer to makers as "consciously

engaged in constructing a public entity" (n.p.). By building 'buddies' to be shared at the

open house, students in this program were indeed building public entities while also —

potentially — constructing their own knowledge of mindfulness (see Figure 3 below). A

number of examples suggest that this was the case. It was clear that the physical

representations of learning these students were building were the 'object[s] to think

with' discussed in the literature review (Halverson, 2013; Litts, 2015; Reisberg, 1987).

Building these objects concretized knowledge that might otherwise have remained

entirely cerebral and therefore intangible.
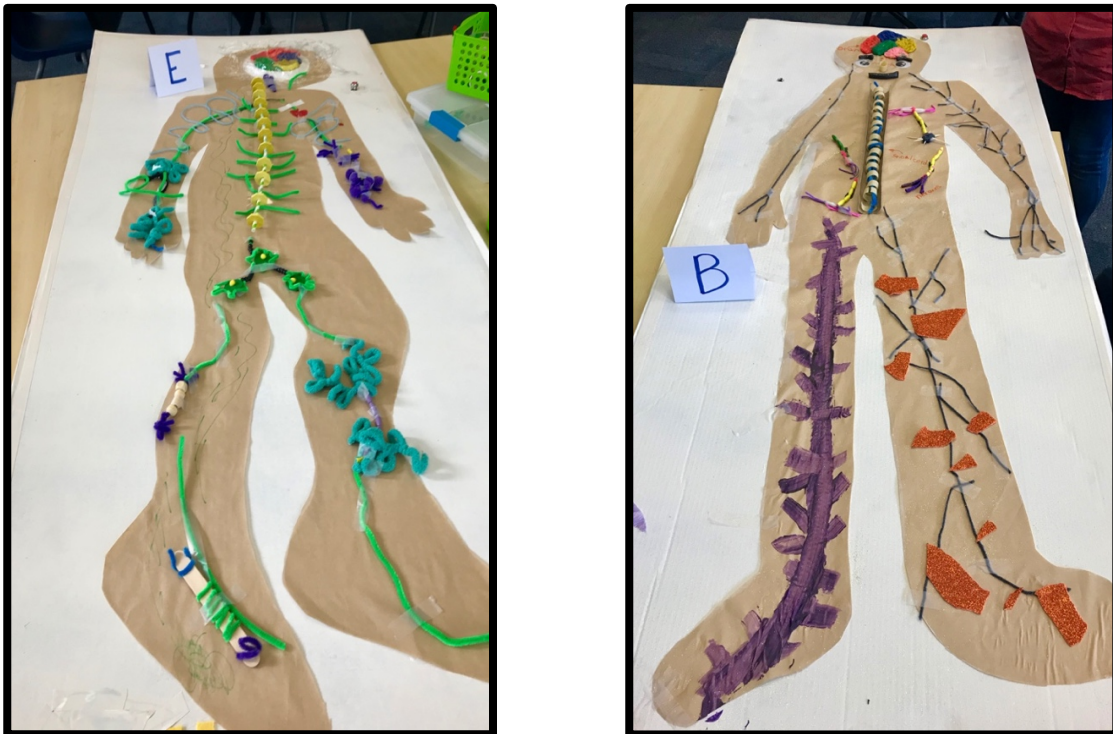
Figure 3 – 'Objects to Think With'. Two of the groups show off their
'buddies' in session seven. May 2019.

In session one, for example, the observer watched as group D "put all the different parts of the brain together and then worked to make realistic creases that they filled with glue and called 'sulki' [sic]" (NPO Field Notes, Session 1). In session three, my co-facilitator noted that Nadia "was using vocabulary from the earlier lesson, like 'dendrites' and 'axon terminal' to tell me what she was making" (CF Field Notes, Session 3). In the same session, two students explained what their group was doing: "that's the myelin sheath" one boy said. His peer interrupted, "that's the axon terminal that he's doing. And that," she said, pointing to a particular piece of clay, "is the nucleus" (JEK Field Notes, Session 3). Decidedly tangible, these objects were poked, prodded, and manipulated in a way that seemed to help students understand what they were and how they worked.

In session five, the classroom teacher asked a group of students to explain what they were making. Marie responded, "I rolled up the plastic and used the yellow pipe cleaners to wrap around it. That's the vagus nerve that carries the message from the stomach. See? It's attached down there where the stomach is and there where the heart is" (JEK Field Notes, Session 5). Making scholars Kafai et al. (2012) argue that physical connections lead to mental connections. Similarly, de Castell (n.d.) argues in her work on production pedagogy that insights are produced through the process of production. In this case, Marie physically connected the (yellow pipe cleaner) vagus nerve to the stomach and heart via the (plastic tube) spinal cord in a way that highlighted the importance of the stomach in mindfulness.

In yet another example, Mason suggested that connecting the lights was "like the neurons in our body" because "we put the lights where the body parts were and then we connected them together … so it was like your brain sends a message to there" (Mason's Interview). According to makerspace literature, such connections and insights arise from the tactile manipulation of a made object in a way that cannot happen when the learning is strictly intellectual (Halverson, 2013; Papert, 1993). Max explained it this way: "We built each part of the brain like the pre-frontal cortex and all of those [parts] and then put them together …. Because [we] were putting parts together that gave [us] a better understanding of it" (Max's Interview).

Missing Knowledge and Making Mistakes

Building models also made learning transparent in a way that highlighted gaps in understanding. Non-working features of an external artefact readily revealed what makerspace scholarship refers to as 'missing knowledge' (Kafai et al., 2012; Kafai & Peppler, 2014), forcing students to iron out "minor bugs" that emerged through "knowledge in use" (Papert, 1993, p. 63).

This was most evident in the building of simple electrical circuits and the way these were incorporated into the 'buddies'. Recall from the previous chapter the way in which Michael finally managed to identify an unstripped wire as the issue with his group's LED (JEK Field Notes, Session 7) and the way that Joseph reconfigured his group's circuit to work with a 'Never Closed' (NC) switch (JEK Field Notes, Session 8). In each of these cases — and many others during the circuitry lesson in the sixth session

— students were missing the knowledge of how to complete a circuit and how to fix the problems that arose in attempting it. They were thereby immersed in what constructionist theorists call a reflective practice, one that might provoke internal questions like, "Why doesn't this part work?", "What else can I try?", and "What else do I know?" In other words, a student might reflect simultaneously upon the work in progress and their own thinking, striving to understand what has been learned and what knowledge is yet needed.

In this study, most of the students were so motivated to achieve functioning lights that they led the way in identifying problems, reflecting on what had and had not worked, and trying again. As discussed in the literature review on making, students were "tinkering" with the circuits, iteratively exploring them in a "deep conversation" with the materials at hand (Sheridan et al., 2016, n.p.). This "rich experimentation and innovation" (Litts, 2016, p. 49) sometimes led to surprising results. Group D, for example, had a particularly challenging struggle with electrical tape:

> *Well, when we were trying to put the lightbulb underneath [the cardboard], we were having some problems because whenever we put it together it would fall apart and our whole group was getting frustrated and we just decided to put [the circuit] on the top instead and when the open house day came we just moved the light onto the brain so that it would look like the amygdala was flashing so people could see it.*
>
> (Noelle's Interview)

Though Group D struggled and failed repeatedly to establish a working circuit, their eventual decision to attach it firmly to the top of the cardboard had advantages that they chose to view positively (see Figure 4). Indeed, a number of students in the class ended up using Group D's 'buddy' at the open house as a visual example of how their

own circuits worked. This is very much in keeping with the concept of "productive failure" in making that Kafai and Fields (2018) argue is essential to render mistakes "learning opportunities instead of learning barriers" (p. 5).
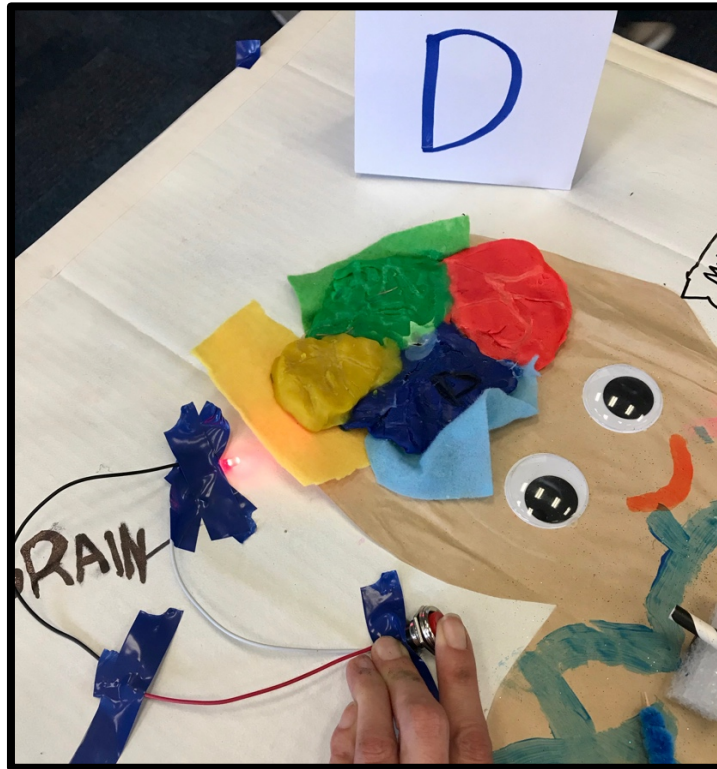
Figure 4 – Group D's circuitry mounted on the top of the cardboard, finally working and visible to all. May 2019.

In her post-program interview, Esther spoke directly about the potential advantages of learning through failure:

> *Sometimes I made a mistake when I was making things and I put things in the wrong place and stuff, but (ummm) most of the time I just fixed it and it worked well, but sometimes the mistakes actually made something better and newer out of it. Like there's that one that Kai did like that nerve system all over and it actually made the spinal cord!*

(Esther's Interview)

Likewise, Noelle wrote that "our group messed up but we kept on trying and we ended up with a really cool thing" (Noelle's Journal, Session 3); Nick said that "if you made a

mistake you could easily just fix it" (Nick's Interview); Carmella said that "when we made a mistake, it was okay" (Carmella's Interview); and Hannah wrote that she learned, "if you made a mistake you just have to let it go" (Hannah's Journal, Session 7). As opposed to traditional schooling where mistakes are discouraged and "tinkering … is often undervalued" (Sheridan et al., 2016, n.p.), makerspace pedagogy encourages students to make mistakes as an essential part of the iterative learning process.

Open House Authenticity

The open house provided an excellent opportunity to watch students share what they had learned about mindfulness (in part) through building their 'public entities'. In keeping with makerspace pedagogy, sharing artefacts and knowledge with an audience was embedded into the project from the beginning (Halverson, 2012; Sheridan et al., 2014). Many of the students eagerly anticipated the open house while two students who were not able to attend expressed their disappointment (Stefie's Interview & Cam's Journal, Session 7). My co-facilitator noted how "excited" the students were "to share what they learned, build neurons, and show off to their peers," in that final session (CF Field Notes, Session 8). Well over half the parents showed up, along with several grandparents, several teachers, the school trustee, and three other grade four classes. There were many interesting examples of students sharing their work with the visitors, but two examples stood out, both of which highlight how much some of these students had learned:

> *When a man stopped by to ask questions, Jacob and Michael talked over each other in their excitement to explain what the amygdala was and why it lit up on their 'buddy'.*

They quite eloquently explained — particularly Michael — about what would happen if you saw a bear and the fight, flight, freeze response kicked in, and how you could calm it by using meditation and other tools. They talked about responding to stressful situations instead of just reacting to them. I was amazed at their understanding and I got to watch them explain this several times over the course of the open house.

(JEK Field Notes, Session 8)

I watched Max explaining his work to a visitor in great detail. That same visitor stopped by afterwards to tell me she couldn't believe how detailed their answers were and how engaged the students were in what they had learned. She referred to Max's explanation and also the way that Marie had talked about neurons, and how their model of the 'buddy' had burned his finger and the neurons had passed that message to the brain at 150 m/s and then the brain told the body to move his finger away…

(JEK Field Notes, Session 8)

In the ways described above, and in contrast to more traditional approaches to mindfulness training, students in this program built their own knowledge of mindfulness by building physical representations of their learning. In addition to this knowledge-building, the act of sharing their artefacts with an audience of teachers, parents, siblings, and peers lent an authenticity to their work that made it quite a powerful learning experience (Halverson, 2012; Sheridan et al., 2014).

Practising Mindfulness while Making

Making, as already noted, is iterative in nature. It often involves a series of attempts and mistakes on the way to a final product, in which each mistake and subsequent redesign requires reflection upon the work in progress. These reflections are part of the "deep conversation" with materials and tools (Sheridan et al., 2016) through which the maker gradually constructs their own knowledge. It is a 'conversation' that can be overwhelming at times, giving rise to moments of frustration and even anger.

Indeed, there were many moments during this program when students struggled with putting their models together, with difficult materials, with tools, and especially with electrical connections. And yet they persevered because, in the midst of these struggles, they were able to reflect on their own thoughts and emotions and have some means of control over them. Students were able to shape adaptive responses to stressful experiences, in part, because mindfulness facilitates sensitivity to the connections between thoughts and physiological responses (Bishop et al., 2004; Paneduro, 2016; Teper et al., 2013).

This is why so much of the program's mindfulness content was focused on connecting physiological sensations with emotions as a way of helping students recognize when they might need to use a mindfulness tool. In session two, students described worry and frustration as "clenched teeth", "butterflies" and "clenched monster toes" (NPO Field Notes, Session 2) as well as "squinting eyes, sweating, and shaking" (CF Field Notes, Session 2). When they experienced sensations like these in their own bodies, they were taught to see them as indications that they might need a tool to help them calm down and/or to let go of unhelpful and stressful thoughts. Like the reflectiveness involved in making, mindfulness is fundamentally about reflecting on the workings of one's own mind. Mindfulness scholars hold that cultivating an awareness of thoughts and emotions generates a powerful ability to reframe those thoughts and regulate those emotions (Bishop et al., 2004; Corcoran et al., 2010; Grecucci et al., 2015; Shapiro et al., 2014; Teasdale, 1995; Teasdale et al., 2002). This central concept in mindfulness was best learned experientially (Gouda et al., 2016) and

the making sessions provided plenty of opportunities for students to put their

mindfulness tools to work.

Putting Tools to Work

One student did say that she got frustrated while making but didn't use a tool to

alleviate that frustration (Noelle's Interview). However, towards the final few sessions

of the program, a number of students clearly recognized a need for the mindfulness

tools and used them to persist through difficult moments in making. In session five, my

co-facilitator noted that Jacob "was trying to get the backing off the double-sided tape."

She wrote that "he was getting frustrated because it was tricky and he said 'square

breathing' out loud." Then she added in parentheses: "He noticed he needed to use a

tool!" (CF Field Notes, Session 5). It was perhaps because the students were never

explicitly directed to use mindfulness tools during the making sessions that it was so

interesting to see it happen. In my own reflection journal following the second session, I

considered asking students about their use of mindfulness while making. On the one

hand, I wanted to encourage them to do this when the making became stressful. On the

other hand, I didn't want students to create stories to this effect.

In the end, I decided not to mention it at all. Instead, I waited to see what they

wrote in their journals or said in their interviews. As previously noted, Jacob explained

in his post-program interview that learning mindfulness tools helped him to "never

[give] up again" when building his challenging 3D puzzles at home. He said that he

learned "to be patient in making" by "doing some mindfulness to get through it"

(Jacob's Interview). In a similar manner, Michael talked about using "square breathing" when "it got a little frustrating" that the light "kept coming loose off the battery" (Michael's Interview). Stefie wrote that she had learned to use mindfulness to calm herself down when she got "frustrated about the light" (Stefie's Journal, Session 7). And Marie wrote after a making session, "I can feel my emotions and use mindfulness tools to calm me down" (Marie's Journal, Session 3). Sometimes, the need to use mindfulness tools was connected more to dealing with peers than with problems in their work. Following session five, for example, Tyler wrote that he "learned the [five] senses helped me when Jacob was talking" (Tyler's Journal, Session 5). Likewise, Joseph struggled with frustration when some of his fellow group members "were messing around with the buddies." He said, "they were messing around with the light switch that I had just finished and I couldn't get it back so I did square breathing" (Joseph's Interview).

By generating stressful situations like these, the makerspace pedagogy in this program provided students with immediate and meaningful opportunities to practise their mindfulness training. In all of the above cases, students exhibited what mindfulness researcher Kabat-Zinn (2013) refers to as a central lesson of mindfulness: the "ability to be aware with intentionality and modulate accordingly the actions we choose to take" so as to cultivate "equanimity in the face of stressful circumstances" (Kabat-Zinn, 2013, p. 315).

Persistence through Making

Mindfulness scholarship claims that students' awareness of their ability to mindfully manage thoughts and emotions helps them to develop a sense of their own agency (Larson, 2011). Indeed, there is a great deal of evidence in the data to show that students reflected on their ability to manage difficult situations by using mindfulness tools. In one of 95 similar examples, Marie wrote, "I learned that many of the mindfulness techniques helped in a stressful situation for me like running track and field. I used square breathing to pace myself" (Marie's Journal, Session 5).

The makerspace pedagogy supported and reinforced these lessons. Through its iterative nature and the challenges of working with various materials, students developed an agentic awareness of their ability to solve the problems inherent in making. Makerspaces have what Sheridan & Konopasky (2016) call an "ethos of resourcefulness" which they explain as a "stance to use what you have and persist and innovate to meet needs and wants" (p. 30). This ethos is evident in a number of examples already discussed, including those related to the electrical circuits and those listed in the previous paragraph. Indeed, my co-facilitator "saw a lot of trying ideas and failing and then trying something new" (CF Field Notes, Session 3). She also witnessed students struggling with materials. Joseph, for example, was "fully fixated on achieving the exact colour of clay as the brain model. Just one section of the brain. He worked on combining colours to get it just right … [but] using the clay was tough." She offered him guidance and then noted that "he took my advice and kept trying" (CF Field Notes, Session 1).

At one point, Carmella got paint in her hair (NPO Field Notes, Session 7); Hannah cut her finger while using a tape dispenser (NPO Field Notes, Session 1); a lack of stickiness on some electrical tape caused one group to struggle throughout session seven to produce one working circuit (JEK Field Notes, Session 7); Group A lost one of their switches (CF Field Notes, Session 7); and Group B's glue bottle dried shut (NPO Field Notes, Session 5). As frustrating as these and many other similar problems were, students learned to accept them as part of the building process.

These frustrations arose through the "trial and error" of making. Managing them required a resourcefulness "propelled through a makers' curiosity" (Peppler et al., 2016, n.p.). Cam's group, for example, had trouble with the brain they built. He explained, "The first day we started the brain, but then in the box it broke so on the last day we made a whole new brain." This made him "worried that they weren't going to finish" but "it felt good" when it "all turned out really good" (Cam's Interview). In Ethan's group, it was the spinal cord that caused some trouble because "the little parts of the spine kept snapping." This was "kind of worrisome," he said, but in the end "we just glued them together" (Ethan's Interview).

Students persisted through such difficulties in order to complete their maker projects and a number of them reflected on this important aspect of making. Referring to her group's lengthy struggles with the circuit, Noelle wrote, "We worked together when we were struggling and even though it didn't work out how we wanted it to we still had fun" (Noelle's Journal, Session 7). Esther wrote, "I liked how nobody wanted to give up when our circuit wasn't working. The team's determination and perseverance

was great!" (Esther's Journal, Session 7). And Kristin wrote, "I persevere in tough

moments" (Kristin's Journal, Session 6).

Ethan's Difficult Day

It was Ethan, however, whose behaviour in session three was perhaps one of the

most striking examples of learning about persistence through making. Halfway through

the making part of the session, he came to me for help:

> *Ethan showed me what he was working on. He had a piece of pale blue pipe-cleaner tightly wrapped in a circle with dark blue felt in one hand and orange pipe-cleaners wound around one another in the other hand. He was trying to put the two parts together to make a neuron. 'I tried glue, I tried tape, and nothing will make this thing stick!' he said. He seemed frustrated but still really engaged in the work. I looked more closely at what he was showing me. I was hesitant to make a suggestion. After a second he said, 'Do we have anything else I could use? Like double-sided tape? That might work.' I smiled and told him where the tape was. He went off to find it.*
>
> <div align="right">(JEK Field Notes, Session 3)</div>

Approximately 10 minutes later, I returned to Group C to check in on how Ethan was

doing. He was still trying to put the two pieces together:

> *He looked up at me and said, 'the double-sided tape just keeps sticking to me!' Now I could see that his jaw was clenched as he bent over the two pieces of neuron on the table in front of him. As if speaking to himself, he said, 'maybe I can just try the regular tape again'. It was quite impressive to see him persisting through so much frustration. I crouched down next to him so that he could see me smiling and said, 'you seem a little frustrated'. He rolled his eyes a little and grinned at me. 'Well yeah,' he said, 'This is really hard!'. I told him that I thought he was doing great and I couldn't wait to see how he fixed the problem. He smiled and then turned back to his work.*
>
> <div align="right">(JEK Field Notes, Session 3)</div>

Ethan continued to work on fixing this problem throughout the entire session. By the

end, he had solved it using the double-sided tape. In his post-program interview, he

said that he had found the situation "kind of annoying because it sticked [sic] and then I left it for a bit and when I picked it up to glue onto the buddy, it fell apart" (Ethan's Interview).

In a traditional school format, Ethan's work in this session would likely have been measured by his productivity, by which standard he hadn't accomplished much. Over the course of approximately 45 minutes, Ethan had managed to make one neuron out of pipe-cleaners and felt. However, viewed through a constructionist lens, he had in fact accomplished quite a bit. He had immersed himself in "the process of making — in tinkering, in figuring things out, in playing with materials and tools" (Sheridan et al., 2014, p. 528). He had experimented with a number of different methods of adhesion, he had encountered failure repeatedly, he had persisted through these failures, reflected on his own knowledge, and continued to come up with new approaches. Eventually he was successful in solving a difficult problem. By overcoming numerous obstacles inherent in the iterative nature of making, he had learned to see himself as a determined problem-solver (Gee, 2003). He had figured out that "I should try more options before I give up on something" (Ethan's Interview). In other words, he had learned to persist.

Transitions: From Chaotic to Calm

Though unforeseen while planning the curriculum, the combination of makerspace with mindfulness pedagogies provided repeated opportunities for students to witness mindfulness tools at work and to practise using them to make smooth transitions between activities. In my first interview with the classroom teacher, she

pointed out that she was having trouble getting her class to the Learning Commons on time because they struggled with transitions. She said that "working with this particular group of kids … timing is always going to be our biggest hurdle" and then explained that she was surprised they weren't any faster at making transitions than her previous kindergarten class had been (Teacher Interview 1). I didn't give this much thought at the time except in making some adjustments to our schedule.

Though we did not foresee any possible effects on students transitioning between activities, we did put mindful practices to use as effective classroom management tools. In session four, for example, while the students were arriving in the Learning Commons and gathering at the front of the room, I "pulled the group's attention together by leading them in square breathing." Quite loudly, I asked them, "What am I doing?" As I said this, I "trac[ed] a finger in the air in the shape of a square." I saw the recognition on some faces and, very quickly, students joined in until we were all doing the square breathing exercise together. "The room quietened and the energy level lowered until everyone was focused on me, ready to begin the class" (JEK Field Notes, Session 4). My co-facilitator noted that this exercise, "brought the students' energy down and they quickly settled as a group" (CF Field Notes, Session 4).

Often, we would use a tool like this to help us transition from the loud, frenetic energy of making to a quieter, more focused lesson on mindfulness. In session three, "While waiting for everyone to [finish cleaning and] gather at the front, I led [the students] in a five senses exercise and the energy in the room calmed down gradually

but quickly. My voice got softer and the noise dropped until all the students were sitting and waiting for the next activity" (JEK Field Notes, Session 3).

Following the making portion of session seven, the students gathered as usual at the front of the room, still buzzing with energy from putting the final touches on their 'buddies'. I said, "We need to take a breath" and asked everyone to raise one hand. "Almost as one, the students copied me by raising one hand in front of them" while pointing at it "with the index finger on the other hand." They quickly figured out that this was the finger breathing exercise. Starting at the thumb, "we traced each finger and breathed slowly in and out [until] there was a palpable shift [in energy] and the students became calm and focused" (JEK Field Notes, Session 7).

These infusions of mindfulness were in addition to the pre-planned meditations and mindful practices that we were doing as regular parts of the curriculum. Students were therefore calming down and redirecting their attention by using mindfulness tools several times each session. As I discussed in the literature review, such "attention-switching" — as part of the self-regulation of attention — is a key skill thought to be honed through mindfulness training (Bishop et al., 2004; Shapiro et al., 2006). Surprisingly, this practice appeared to impact students' ability to transition between different activities in their classroom as well. Almost four weeks into the program, the classroom teacher noted the growth she had seen in her students in terms of what she saw as their burgeoning "flexibility":

> *I'm contrasting to the way they were at the beginning of the year, but I think even just over the last few weeks …. For them to actually stop and think and move through an activity in a calm manner is huge. For them to be able to redirect themselves and say, you know, I was stressed out about this but now I'm not. And I really think that they are,*

whether it's outward or an internal thing, I really think they're using those [mindfulness] techniques to redirect themselves and to calm down.

(Teacher Interview 3)

The following week, she continued to talk about her students' ability to handle

transitions:

Today, even though we had a period of a lot of transitions and change that can make them quite unsettled, when they came back into the classroom, they were all actually really calm and focused and they were able to get down to work. We were working on a math assignment, and they got right down to work and normally that wouldn't have happened. Although they might not be specifically reflecting that this is because of MakerMinds … it can't be a coincidence, as far as I'm concerned, knowing this group of kids. They're getting a little bit deeper into these mindfulness techniques and they're making conscious decisions to calm themselves before periods of study.

(Teacher Interview 4)

Though the students' punctuality never improved, their attentional 'flexibility'

witnessed by the teacher was seemingly a result of their repeated use of mindfulness

tools to transition between the high and low energy activities in this program.

Social Learning through Making

Mindfulness activities are often conducted alone as part of a personal practice.

However, mindfulness scholars claim that the prosocial outcomes of mindfulness

training, like compassion, empathy, and respect for others, suggest that it is well-suited

to being used in social situations (Davidson et al., 2003; Shapiro et al., 2007; Shapiro et

al., 1998). This study's combination of mindfulness training with the social affordances

of makerspace pedagogy presented students with situations in which they could

practise mindfulness-related social skills while also leveraging what many scholars

refer to as the fundamentally social nature of learning (Gee, 2003; Vygotsky, 1978; Lave

& Wenger, 1991; Wenger, 1998). With regards to the latter, the benefits of collaborative learning were most apparent in the way that students shared their labour, their knowledge, and their feedback throughout the making sessions (see Figure 5). In session three, for example, I noted that group F had "decided to [each] make different parts of the neuron and then put it together" afterwards, but they were also "talking to each other throughout the process to work out who was doing what and to announce what they were making and what they were using" (JEK Field Notes, Session 3). Similarly, my co-facilitator observed that group A "progressed quickly in making neurons [and] seemed to work well together, each doing parts of one neuron and then bringing them together to make it whole" (CF Field Notes, Session 3). In session five, the observer watched this same group "break up the workload" by having two group members work on nerves while the others worked on the spine (NPO Field Notes, Session 5).

Similar scenes played out in every making session. Braelyn explained it this way: "Well, me and the girl that was doing it with me, we did it together … she helped me so … I would make the clay and she would paint it while I was trying to shape the clay" (Braelyn's Interview). Max also enjoyed how "the work is … split" (Max's Interview) and Michael appreciated that "Instead of being by yourself and you had to focus on many things, we could split [the work] up and I could be working on one part of the brain and the others could be working on other parts" (Michael's Interview). In dividing the work this way students were not merely being efficient, they were in fact sharing their knowledge and ideas as they built one final 'buddy' per group.

Figure 5 – Making together while sharing labour,
knowledge, and feedback in session three. April 2019.

Sharing Knowledge and Feedback

Although this knowledge-sharing occasionally led to accusations of 'copying'

between groups (JEK Field Notes, Session 5 & 7), there was much more evidence that it

was both helpful and appreciated. Group B, for example, chose to make three or four

different neurons at the same time rather than contributing to one. Still, they talked as

they built, sharing "what materials they were using and how they were making each

model" (JEK Field Notes, Session 3). Group D was also observed, "bouncing their ideas

off each other and working really closely" as they put together "quite a complex model

using layers of clay, some paper, small pompoms, and toothpicks" (JEK Field Notes,

Session 3). In session seven, this same group was observed working together "to get the

LED through the middle of their brain." To do this, "one student used a pencil, another used the tip of scissors, and one [tried] push[ing] the light up from the bottom while another worked on making space for it" (JEK Field Notes, Session 7). Sometimes, this sharing of knowledge meant capitalizing on a group member's particular strengths. For example, Michael became known as "the electrician guy" in his group (JEK Field Notes, Session 8); Joseph took charge of the LED in his group (Nick's Interview); and Ethan taught his group mates how to complete an electrical circuit (JEK Field Notes, Session 6) and was also appreciated for his skills in art (Nadia's Interview).

Providing feedback to one another was also a key feature of this collaborative approach to learning. This was perhaps clearest when students asked each other for help, like when Nick was "cutting out felt to make dendrites and check[ed] in to ask [his group] if he should use another colour." In this case, my co-facilitator noted that Nick was "looking to others for help and direction and openly receiving that help" (CF Field Notes, Session 3).

At other times, feedback was provided unsolicited. Marie, for example, tested the switch on her group's LED and then told Maya with some excitement to turn it "the other way, the other way!" When Maya followed her instructions, the LED lit up and Maya shouted, "it works!" (NPO Field Notes, Session 7). Likewise, Nadia watched Braelyn struggle to feed a wire through cardboard and then told her to "go through the top" so she could "be more precise" (NPO Field Notes, Session 7).

Feedback like this — both solicited and unsolicited — is considered to be "commonplace and a key driver of learning" in makerspace pedagogy (Sheridan et al.,

2014, p. 515). For Max, working collaboratively meant that "you have all these neat ideas from everybody in your group and … people come up with new ways that you didn't think about (Max's Interview). Esther saw the maker groups as able to "expand your ideas" (Esther's Interview), and Noelle "liked that we all contributed our ideas … [and] we helped each other when we were struggling" (Noelle's Journal, Session 6). In each case, students were "leverag[ing] the knowledge in [the] network" of the group rather than attempting to build that knowledge alone (Gee, 2003, p. 189). From a constructionist perspective, the social context "shape[d] the learning trajectory and … [was] a repository from which learners [drew] resources to work out their thinking" (Litts, 2015, p. 40). The examples provided suggest that students' comprehension of mindfulness-related content was indeed positively impacted by the 'social context' of making and learning in collaboration with others.

Building Bonds

Student-participants also appeared to gain social-emotional benefits from the combination of mindfulness with makerspace pedagogies. The extended and collaborative nature of the maker project positioned students to form connections with each other. These connections were encouraged through the 'simple joy' of making something together (as discussed above). In large part, however, these connections were encouraged through the knowledge-sharing aspect of making that engendered a sense of inclusivity (Hughes et al., 2016; Sheridan et al., 2014; Taylor et al., 2016).

In the previous chapter, there were a couple of situations identified where students felt left out (Jacob's Journal, Session 5; CF Field Notes, Session 7), but the majority of student-participants expressed a sense of inclusiveness in their groups. Esther, for example, "liked the team collaboration a lot" and the way that "no one was left out" (Esther's Interview); Cam enjoyed that "not one person was left out" (Cam's Interview); Hannah appreciated "how every idea was considered no matter who contributed it and what it was" (Hannah's Journal, Session 1); Kristin loved "hanging out with [her] group and sharing ideas" (Kristin's Journal, Session 1); Halil liked that his "group worked well … most of the time" (Halil's Journal, Session 5); and Noelle appreciated that "we all contributed our ideas" (Noelle's Journal, Session 6).

In addition to knowledge-sharing, students maintained connections within their maker groups by practising what mindfulness scholars refer to as their prosocial mindfulness skills (Broderick & Metz, 2009; Jennings et al., 2011; Shapiro et al., 2007; Shapiro et al., 2014). As mentioned earlier, this was most evident when students used mindfulness tools to mitigate potential conflicts and control frustration. Isaac, for example, used his breathing when some of his group members "got off task a bit" and he got "a bit angry … and thought we weren't going to finish" (Isaac's Interview). Cam used mindfulness tools when his group "was a bit silly" and he wanted "to get them back to a working mindset" (Cam's Interview). And Tyler used the five senses exercise to manage his frustration when Jacob was talking too much (Tyler's Journal, Session 5).

As discussed in the literature review, by "evoking mindfulness" when needed, these students were putting to work what they had been taught about "skillfully

responding to situations that [would otherwise] provoke emotional reactions" (Bishop et al., 2004, p. 15). They were responding rather than reacting; in doing so they exhibited a certain social competence that mindfulness scholars claim stems from actively regulating their own emotions (Broderick & Metz, 2009; Roeser & Peck, 2009; Schonert-Reichl & Lawlor, 2010). As their teacher observed, students gained "a toolkit to deal with things, to approach things" and this led to "an overall sense that if there's any verbal conflict, it's easier to diffuse" than it was before their experience with the program (Teacher Interview 5).

The extended nature of the maker project also forced students to navigate the social challenges of their groups and practise using their 'toolkits' over the course of eight weeks. For their teacher, "having an unusually large project like this with groups that they were not able to self-select" presented a real challenge for her students. She felt that the length of the project enabled them to "grow in their capacity to work together" and that "they were able to work through" the challenges of this extended project "in a calm manner" by using the techniques they had learned (Teacher Interview 3).

Conclusion

In this chapter, I discussed the student-participants' preference for 'making' days, and the somewhat incongruous finding that most believed they learned more on the 'non-making' days. I have also identified and described a number of important ways in which making and mindfulness interacted throughout this eight-session

program. This includes how constructionist making helped students to learn about mindfulness; how makerspace pedagogy generated opportunities for students to experientially learn mindfulness; how practising mindfulness in and around making helped students with transitions; and how the social affordances of making deepened students' understanding of mindfulness. In contrast to traditional mindfulness training programs, MakerMinds leveraged makerspace pedagogy to serve several related purposes. It helped to hold students' attention and keep them engaged in mindfulness content throughout the program; it positively impacted their conceptual and experiential knowledge of mindfulness; and it helped them to develop an agentic awareness of themselves as persistent, problem-solving makers and nascent mindfulness practitioners.

Chapter Seven: Conclusion

Lessons Learned

In this dissertation I have argued for the need to provide young people with programs that promote mental wellness, particularly given the extraordinary rates of anxiety and depression evident amongst children and youth today. I have further argued that schools provide an ideal place for this programming to reach as wide and as diverse a population as possible and that mindfulness training programs are growing in popularity, in part, because related research has shown them to promote mental well-being amongst adults and children alike. Though increasingly popular, apparent difficulties with fully engaging young people in these traditional mindfulness training programs is a problem that needed to be addressed. It was this issue that motivated me to create a non-traditional program, one aimed at teaching mindfulness to students using the deeply engaging constructionist approach to learning found in makerspaces. As an initial exploratory study of this unique approach to teaching mindfulness, this dissertation examines how mindfulness and makerspace pedagogies interact when combined into one curricular intervention.

Conclusions

As an ethnographically informed researcher and co-facilitator of MakerMinds, I was both an observer of this curricular intervention and a participant in it. I thereby gained an intimate understanding of the students' experience with this eight-session program that was further enriched by the multiple methods and multiple sources

through which I collected data. Throughout the project, I focused particularly on the thoughts, opinions, and reflections of students themselves via their weekly reflection journals, their post-program interviews, and quotations captured in class. This focus enabled me to centre students' voices in the research, both in the process of interpreting the data as well as in the final product itself. Though my foregrounding of student voices is in line with ethnographers' commitment to "interpreting the point of view of those under study" (Atkinson et al., 2001, p. 43), it's important to note that my ability to fully perceive, interpret, and centre those voices was likely limited at times by my own interests and aims in this research.

First and foremost, the combination of mindfulness with making produced a program that was successful in engaging the vast majority of its student-participants in both pedagogies for the full duration of eight sessions. Indeed, all of the students in this study reacted positively to MakerMinds overall and all of them learned to use mindfulness tools on their own in times of stress or difficulty, a central goal of the program. Of course, there were varying degrees of engagement amongst the students as well as varying degrees in uptake of the mindfulness content. In this particular class, I found that there were, in fact, four thematic groups of student-experiences. There were students who experienced MakerMinds as *Enthusiasts*, as *Reticent* students, as *Distracted* students, and as *Builders* with each of these themes representing a distinct mode of participating in — and/or reacting to — the program content. This finding — explored fully in chapter five — suggests that the unique combination of mindfulness training

with makerspace pedagogy worked to reach different students differently and yet all of them to some degree and in varying ways.

In terms of how the two pedagogies interacted, the data revealed a number of notable findings described in detail in chapter six. These findings were related to student preferences, to constructionist and experiential learning of mindfulness, to transitioning between activities, and to the social affordances of makerspace pedagogy. First, the vast majority of students preferred 'making days' to 'non-making days' and yet most of them also believed — perhaps erroneously — that they learned more on the 'non-making days'. Second, using the constructionist approach of making to learn about mindfulness helped students to concretize their knowledge and fill in gaps in their understanding. It also gave them the motivating and validating opportunity to share their knowledge of mindfulness with an embedded audience. In addition, the makerspace pedagogy deepened students' experiential understanding of mindfulness by creating stressful situations that they learned to navigate using their newly acquired mindfulness tools. At the same time, working through the inherent challenges of making reinforced students' understanding of themselves as able to persist through difficulties. Third, the repeated use of mindfulness tools to move students from chaotic making sessions to calmer program elements deepened students' experiential understanding of mindfulness while positively impacting their ability to smoothly transition between activities in the classroom. Finally, students leveraged the social nature of makerspace pedagogy by sharing their labour, by sharing their knowledge and feedback, and by building and navigating relationships with one another over the

course of what was an unusually extended school project. In sum, the makerspace pedagogy worked to hold students' attention and deeply engage them in the mindfulness content. It positively impacted their conceptual and experiential understanding of mindfulness and their ability to apply that understanding in their daily lives. And, in the end, the combined pedagogies developed students' self-awareness as both problem-solving makers and nascent mindfulness practitioners with the skills to better manage their own emotions and persist through difficulties.

Limitations and Lessons Learned

Though the MakerMinds program was largely successful in achieving its aims, it is important to reiterate that this research was entirely exploratory rather than experimental. The findings here are not generalizable; they are instead confined to this particular version of the program, in this particular school setting, with this particular set of students. Also, because the two pedagogies were so thoroughly integrated from the outset, they cannot be teased apart in the final analysis to attribute a finding definitively to one pedagogy over the other. And there are a number of other limitations that are worth discussing. Some of these limitations are related to the participants and location under study. Others concern the challenges of successfully implementing makerspace pedagogy and mindfulness training in any school setting.

Time Pressure and Curricular Constraints

Educators and researchers who use makerspace pedagogy in the classroom inevitably face "structural challenges" (Halverson & Sheridan, 2014, p. 500) of the school system that impact their faithful adherence to constructionist principles. A particularly pressing structural challenge exists in the time constraints that are imposed by the rigidly organized nature of the typical school day. Indeed, school "insists on timed activities, with no room for "losing track" of time by being absorbed in reading a book or solving a math problem" or, presumably, losing oneself completely in building an external artefact (de Castell & Jenson, 2003, p. 51). Unsurprisingly, 'time pressure' arose as one of the most commonly coded themes in this study and I have already described (in chapter four) how this issue affected the final content of MakerMinds. In addition to impacting the way that students learned about electrical circuits and reducing how often they were immersed in mindful movement activities, time constraints meant that meditations were cut short, mindfulness discussions were curtailed, and raised hands were sometimes ignored when we had to move on to the next activity in the program. However, time pressure was most impactful in how it limited students' freedom to explore their own making. Constructionist scholars "value the *process* involved in making — in tinkering, in figuring things out, in playing with materials and tools" (Sheridan et al., 2014, p. 528). This tinkering takes time. Unfortunately, there was never enough of it available to allow students the free range in making that I wanted to provide. They did not have the "time to think, to dream, to gaze…" that Papert and Harel (1991) envisioned in a system more conducive to

learning and personal growth. Approximately forty minutes into each making session, no matter what the students were up to, a facilitator had to call out a warning that there were only five 'making' minutes left. Twice the teacher took on this task, once by calling out a minute by minute countdown and another time by using a digital countdown clock on the large screen. Both times, students around her rushed to finish up what they were doing, with groans and sighs indicating their displeasure (JEK Field Notes, Sessions 1 & 5). Cutting students off in mid-thought and mid-build was clearly antithetical to the constructionist ideals behind MakerMinds. It was, however, completely normal to the participants in the context of a school day. Even in the midst of a new realization or a sudden inspiration, students understood that, if the bell was about to ring, it was time to pack up and move on.

Time pressure particularly affected the way that students in this study were introduced to electrical circuitry. Though I initially intended to facilitate a student-directed exploration of circuits in keeping with makerspace pedagogy, this proved unfeasible. Given the short amount of time and the large number of students that we had, I reorganized the lesson so that it was fully scaffolded. This was the only way that I could give all of the students a chance at participating meaningfully in the final making session in which they integrated working circuits into their human cutouts. The lesson was still hands-on, but it was also very much teacher-led, and students worked from kits with their learning supported by step-by-step instructional diagrams (see chapter four for a more detailed description of this lesson). Once again, time pressure limited

my ability to faithfully follow constructionist principles and the students' ability to freely explore the available materials and build their own knowledge.

Finally, the time constraints of the school's schedule combined with the curricular constraints of the school system to shape what could and could not be taught. With limited amounts of class time available and a large set of topics to cover, teachers are hard-pressed to fit in projects that don't also meet curriculum standards. Whereas a constructionist approach to learning might begin by having students choose their own topics and projects of interest, this amount of freedom is often quite unrealistic in a classroom situation. In the case of MakerMinds, I built choice into the making sessions but not into the topic itself. That is, students had freedom in *how* they put together their human cutouts, but not in the specifics of what they would learn about mindfulness-related physiology or even, more generally, if they wanted to learn about mindfulness at all. Instead, these decisions were made by me in consultation with my co-facilitator, the teacher, and the school administrators. In order to be welcomed into the school, the content of the program had to meet standards set by the Ontario Ministry of Education. In this case, MakerMinds covered aspects of the grade four science, health, literacy, and art curriculum, so the classroom teacher felt justified in allotting this program some of her limited instructional time.

Teaching Mindfulness in Schools

In addition to the challenges of implementing makerspace pedagogy in schools, there were also challenges particular to the school setting that limited how well I was

able to incorporate certain mindfulness lessons and practices. Once again, time pressure was an issue. As mentioned previously, we had to cut out the mindful moving activity on 'making days' to fit the tight schedule and a number of class discussions were cut short. In addition, students often had their hands up to ask a question or share a mindful experience but time constraints forced us to move on without letting them speak (JEK Field Notes, Sessions 2, 4 & 6; CF Field Notes, Sessions 2 & 5). This, of course, happens regularly in a school setting and students are accustomed to putting their hands down without sharing their thoughts. However, given how new this mindfulness content and the related practices were to students, it would have been helpful to explore their questions and experiences in greater detail. This time pressure also impacted the way that we taught certain mindful practices. In particular, the tight schedule forced us to cut down on the length of meditations and even, strangely, to speed them up in some cases (JEK Field Notes, Session 2 & 4; CF Field Notes, Sessions 2, 4 & 7). Though the students never indicated that they noticed these adaptations, rushing through such activities undermined the length and depth of students' experience with them.

These mindful practices were also impacted by the constant interruptions that take place in a school setting. Announcements over the loudspeaker, the sudden arrival of other classes (despite the signs asking them not to enter), and the coming and going of students looking to use a printer or check out a book — these sorts of interruptions happened regularly and they undermined the quality of mindful experiences we were trying to provide. With all of these interruptions — along with jarring bells signalling

class changes, demands of teachers and administrators, and the competing needs and energies of hundreds of young people in one building — schools can limit a facilitator's ability to successfully carry out mindfulness training.

Once again, however, I would argue that the stressfulness of today's school setting — though far from being acceptable — is also what makes it an appropriate place to teach mindfulness. As discussed in the literature review, being mindful is about being open and receptive to all of life's experiences and skillfully responding to them, including stressful moments. (Bishop et al., 2004; Meiklejohn et al., 2012; Poulin, 2009). It is more a way of approaching life than something that happens only when the practitioner is alone in a calm place. Having students learn to practise in the setting where much of their lives unfold, while difficult, is also more in keeping with the espoused aims of mindfulness scholars. More importantly, if young people are indeed carrying out their days in stressful settings, this first and foremost indicates a need for significant changes that reduce those stresses and make "schools more rewarding and congruent with individual well-being, priorities, and values" (Gouda et al., 2016, p. 14). Meanwhile, programs like this one do well to offer students coping skills and some respite.

Resource Constraints

Implementing makerspace pedagogy in the classroom can be resource-intensive, both in terms of the cost of materials and in terms of staffing. The cost alone can be prohibitive for many school boards, classroom teachers, or, indeed, researchers. For this

study, I sourced a number of materials from recyclables collected ahead of time and craft supplies from earlier projects. I also purposely chose to integrate a relatively inexpensive technology into the project by having students create their own electrical circuits instead of incorporating more complicated technologies that can be costly and therefore non-existent in poorer schools. I attempted to create a program that would be financially feasible for as many schools and teachers as possible. Still, despite my best intentions, providing a variety of materials for a class of 26 students meant hundreds of dollars spent at local dollar stores and an electronics outlet. Even with a relatively low-technology program like MakerMinds, such costs could limit its implementation to more affluent school districts.

In addition to being resource-intensive in terms of cost, carrying out a successful class-wide makerspace project also requires more than one facilitator. This might limit the use of makerspace pedagogy in schools with staff shortages and/or limited access to qualified volunteers. As previously discussed, the making sessions in this study were exciting and engaging, but they also ran quite smoothly. We had 26 students in the room and very few incidents that required discipline. Those incidents that did occur were minor. There were no students whose behaviour undermined the making in any significant way. One possible reason for this was the number of adults present in the room. I was fortunate to be working with a co-facilitator with whom I shared the teaching load and to also have the classroom teacher present throughout the program. In addition, we had a fourth adult on hand as the observer who also happened to be a newly certified teacher. Though she refrained from interacting with the students as

much as possible, she did wander amongst them as they worked, watching carefully and taking notes. It's possible that her presence felt like that of another authoritative adult. In effect, then, there was a ratio of six study participants to every teaching adult (the ratio changes to 6.5 if we include all of the students present). Two of the adults present (myself included) were also experienced teachers, so we were in a good position to facilitate the program while minimizing distracting behavioural issues when they arose. Though it's impossible to be certain that our student-teacher ratio prevented disruptive behaviour and kept students on task, it's reasonable to think it might have helped.

This is not to suggest that the students were restrained in any way. The making sessions still bordered on chaotic. With unbridled access to a table full of interesting materials and 40 to 45 minutes to freely use whatever they wanted, students threw themselves into building their artefacts. They were loud, energetic, and completely messy but they were also generally engaged and very productive. To be this productive, they needed the assistance and encouragement of their teachers. In fact, keeping this entire class functioning well required the constant attention and facilitation of four teaching adults, two of whom stayed in the Learning Commons for an hour after each session to clean up what the students left behind.

Figure 6 - The materials table after a typical making session.

Implications for Future Research and Practice

Merging mindfulness training with makerspace pedagogy produced a program that was successful in engaging students in the mindfulness content and encouraging their application of mindfulness tools as needed in their daily lives. The vast majority of students in this program remained engaged throughout the eight sessions and all of them gained experience in using mindfulness tools to support their own mental well-being and to persevere through difficult moments. I am hopeful that many of them will continue to make use of these tools and that some students will be inspired to further pursue the potential benefits of a personal mindfulness practice. At the same time, the making sessions were successful not just as a means of learning about mindfulness but

also in their own right. That is, many students gained confidence in their ability to solve difficult problems, to work with electrical circuits, and to persevere through the challenges inherent in making. I am hopeful that this experience will inspire some of them to pursue their interest in making and to continue seeing themselves as capable learners and builders.

The exploratory study of this program generated a number of interesting findings about the ways in which mindfulness and makerspace pedagogies interact when carried out in a single curricular intervention. This research contributes to the existing literature on mindfulness by proffering an alternative approach to mindfulness education for young people. In particular, the modelling/building of mindfulness-related physiology constitutes a unique approach to mindfulness training that could be used by mindfulness educators and studied in greater detail by mindfulness researchers. There is also potential for a follow-up study with the same group of student-participants to assess their ongoing use of mindfulness practices. Such a study might be particularly valuable in the context of the current (in 2020) Covid-19 crisis and the stress and social isolation this virus has imposed.

This exploratory study contributes to the existing literature on making by extending current conceptions of pedagogical applications to include mindfulness studies. Future related studies could explore how making contributes to mindfulness by being an inherently mindful activity. Further research could also involve greater choice in terms of the overall makerspace project as well as greater variety in the makeup of student groups.

As the findings are limited to this particular study, further research would be required to determine if the combined pedagogical approach is as successful with other students and in other settings. In particular, future research with more diverse groups of students and in less affluent school settings would be worthwhile. In addition, future experimental studies of this particular program would be helpful in determining the efficacy of this combined approach as compared to more traditional and non-making mindfulness-based programs.

Though not intended as an indictment of our current education system, much of what I have written here might well be taken as critical of the ways in which the system inhibits students' learning as well as its role in contributing to students' mental distress. These are both important considerations, worthy of further discussion and study. For now, however, I would argue that the MakerMinds program stands as an example of how makerspace pedagogy has the potential to enrich students' learning of meaningful and complex subjects like mindfulness, such that researchers and educators should be encouraged to attempt its use in teaching similarly abstract content. Finally, the enthusiasm with which MakerMinds was embraced by students is perhaps a testament to its quality. But the enthusiasm with which this curricular intervention was embraced by parents, by the teacher, and by school administrators is a testament to something far more significant. It reflects how clearly they recognize the need for programming like this that supports and promotes the well-being of the young people in their charge.

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Appendix A:

MakerMinds Curriculum

<u>Program Overview:</u>

Using mindfulness training and the joy of making
to promote mental wellness amongst children and youth

The MakerMinds program combines makerspace pedagogy with mindfulness training to promote mental health for students in the junior grades. Students learn about the nature of mindfulness and how its various techniques can be used to understand and manage thoughts and emotions, reduce stress, and promote overall mental well-being. Over the course of 8 weeks, students engage in 8 sessions of a mindfulness training program based, in part, upon the well-known, widely studied, and highly successful Mindfulness-Based Stress Reduction (MBSR) program created in 1979 by Jon Kabat-Zinn. Throughout these sessions, students work together in small groups to create a number of shareable physical representations of the brain-body processes affecting their mental well-being. The production of these models involves the sort of student-led, hands-on, creative, and solutions-oriented thinking common to makerspace pedagogy. This means that every participant's ideas and contributions are necessary to and valued in successfully completing the project. Throughout the program, lessons in mindfulness are meaningfully connected to the ongoing project-work. At the same time, the project-work reflects and develops participants' understanding of the core content. And, at the end of the program, parents and other visitors are invited to a final session in which students can proudly share their models and all of the new knowledge they have built together with their peers.

<u>What Do We Make?</u>

Participants in this program work in small groups to build a life-sized human cutout that incorporates a number of models, each one representing students' growing understanding of the brain-body connections related to mindfulness and mental well-being. These models include:

- A brain hemisphere
- Neurons
- A spinal cord
- The sympathetic and parasympathetic nervous systems
- An option to include depictions of the body parts most affected by stress and mindfulness

With some STEAM….

In addition, a short lesson on **simple electrical circuits** leads to students adding switches and lights to any aspects of their human model they wish to highlight. This means they might set a switch to light up the amygdala or run a string of LEDs along the spinal cord to represent messages travelling to and from the brain. Students are encouraged to explore these technologies and incorporate them in whatever creative manner they like!

Most importantly, in keeping with makerspace pedagogy, students are asked to use the materials provided to *represent their own learning in the way that makes the most sense to them.* This means that no two models will end up being the same.

What Do We Learn?

The Core Content consists of three intersecting themes:

Mindfulness

How can we stay present in the current moment? How can we pay close attention to what's happening right now? Why is that even helpful? Students will learn what being mindful means and how to use a wide variety of mindful tools to relieve stress, feel calm, and improve their overall sense of wellness.

MakerMinds

Neuroscience

How does the nervous system work? Students will learn how the physiology of the brain and body function in relation to thoughts and emotions, with a particular focus on the sympathetic (fight/flight) system and the parasympathetic (rest/digest) systems. This will help them to understand the connections between what they think and how they feel.

Metacognition

How can we think about thinking? Students will learn how an awareness of their own thoughts and thought patterns can help them to regulate their emotions. Through mindfulness practices and an understanding of what thoughts and emotions are, they will learn to create a powerful space between their thoughts and their reactions. This space is essential to emotion regulation and a key to mental wellness.

<u>Neuroscience.</u>

Students explore…

- The Autonomic Nervous System (ANS) and the fight or flight/rest and digest functions
- The role played by the Vagus Nerve
- The parts of the brain (and those particularly connected to emotions, learning, memories, and anxiety)
- How information travels along the nervous system to and from the billions of neurons in their brains
- Where in their bodies they feel different emotions and how thoughts are connected to physical sensations

<u>Metacognition</u>

Students explore…

- Helpful and unhelpful thinking styles
- Thoughts and thought patterns: how to choose the ones that help us and let go of the ones that don't
- What to do about worries
- How to practise watching, labelling, and letting go of thoughts and emotions
- Being careful with what we say to ourselves
- Understanding others' perspectives
- Pausing to RESPOND rather than REACT

<u>Mindfulness</u>

Students explore…

- Mindful movement
- How to pay close attention to what we see
- How to listen closely
- Mindful activities like eating, smelling, and walking
- Full-belly breathing
- Finger breathing
- Square breathing
- Letting our busy minds settle
- How our minds distract us
- Using our five senses to ground ourselves when we're upset
- Different forms of meditation
- How to go to sleep happily

Potential Maker Project Materials

Human Cutout	*Brain*	*Neurons*
• Thick, large sheets of paper • Googly eyes • Pre-printed drawings of organs • Sticky felt • Paper, markers, scissors, glue, and tape • Thick cardboard backing	• Thick yarn • Coloured clay • Plastic wrap • Paper plates • Coloured paper/Flags • Toothpicks • Macaroni • Paint • Paper, markers, scissors, glue, and tape • Styrofoam balls	• Pipe cleaners (multiple colours) • Various beads • Yarn • Coloured clay • Pasta shells • Various candies • Paper, markers, scissors, glue, and tape
Spinal Cord	*Nervous System*	*Electrical Circuits*
• Thin foam sheets • Egg cartons • Pipe cleaners • String and lifesavers • Yarn • Thin pool noodles (sliced) • Paper, markers, scissors, glue, and tape • Marshmallows? • Half pipes of cardboard	• Glitter paint pens • Yarn, string • Pipe cleaners • Paper, markers, scissors, glue, and tape	• Wires • Battery packs with wires/coin batteries • Electrical tape and duct tape • Scotch tape • Various coloured LEDs • Switches • LED tape • Circuit connectors • Paper and pens for planning circuits

MakerMinds
Session 1
Double Period

Section	Description
Check-in	Welcome and Reminders Hand out lanyards Answer questions
Mindful Moving	Dynamic body scan
Meditation	Body scan/relaxation
Core Content[11]	What is mindfulness? What are the parts of the brain and what do they do? Left and right brain
Making	Human cutout and making brains Clean up
Mindful Practice	Five Senses Exercise
Reflection Journals	Hand out journals (explain with reminders) Allow students time to work independently Collect journals
Homework	Practise '5 senses' at least once during the week.

CHECK-IN (3 minutes)

Reminders: Go over who we are, what's happening today, hand out lanyards, and answer questions.

MINDFUL MOVING (4 minutes)

Dynamic body scan: lift toes, circle ankles, bend knees, straighten legs tightly, circle the hips, forward fold, bend left to right, arm circles, wrist circles, make fists, neck circles, scrund face/clench jaw, end with eyes closed and notice the breath

MEDITATION (2 minutes)

Body Scan/Relaxation:
Seated. Awareness of body without movement. Quick scan of the body.

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[11] The Core Content of every MakerMinds session includes a related slide deck, not included here.

CORE CONTENT (15 minutes)

What is mindfulness? (About 3 minutes)

- When you were doing the body scan, did you notice that your mind wandered a bit? Did you ever catch yourself thinking about something other than the body scan?
- When you sit in class, do you ever notice that you have missed something the teacher was saying because you were thinking about something else? Maybe you were making plans for the weekend or remembering something a friend said to you?
- What about walking to school? What do you think about when you walk to school? Do you think about walking? About the colour of the sky? About the temperature? Or are you off in another world, imagining something that hasn't happened or thinking about the past?
- Our brains are incredible. They are responsible for all that we are and all that we are able to think and feel and do. Think about everything your body is able to do, like run, climb, swim, or ride a bike. Consider all the things you are able to think about, like what you want to eat for dinner or what your favourite colour is or how many planets there are or how a computer works. Think about all the things you remember, from the letters of the alphabet to the faces of your families and friends. Even your feelings and emotions and the fact that you can think about your own self — all of these things happen because of the way our brains work.
- And they work, and work, and work. They protect us from harm. They keep us breathing and our hearts pumping, and they process everything we see, hear, taste, smell, touch, think and feel. And they do this all day when we are awake and all night when we are resting and dreaming. So, we can be thankful to our brains for working very hard for us. But sometimes this constant work can be exhausting. Sometimes, our brains make us think and feel things that really aren't helpful to us. They worry when they don't need to. Or they're scared when they don't need to be. And often, we are so busy thinking about other things — like what the future holds or what happened to us yesterday or something we are imagining — that we don't even notice what is happening right now, at this very moment.
- That is where mindfulness comes in.
- Being mindful is all about paying very close attention to this current moment and everything that this current moment offers. It is about using our senses to be really aware of what is happening right now, all around us and inside our minds and bodies. By paying close attention — especially to our thoughts and feelings — we give ourselves time to think before we respond to things that happen to us. By paying close attention — especially to the world around us — we experience our lives in a way that feels really full. And we learn to do all of this in a way that is really kind, so that we are compassionate with ourselves and others. This is mindfulness.
- Everything we are going to do in this program will help us to understand 'mindfulness' and be able to use it in our daily lives.

First, let's take a closer look at where all of this mindfulness happens.

The brain: (10-12 minutes)

[Put up photo of brain on screen. Also, use the model of the brain. Point out the parts as we talk about them. Pass the brain around the circle]

- [SLIDE 2] Average adult brain weighs 1400 grams or about 3 lbs and contains 86 billion nerve cells (or neurons).
- The brain is very well organized into different areas depending on function.
- The outermost layer is called the cerebral cortex. It is full of tightly packed neurons. All of the folding into grooves and bumps (or sulci and gyri) allows all of that surface area to fit into our skulls.
- [SLIDE 3] We have two hemispheres, each divided into four lobes (frontal, parietal, occipital, temporal). Each area is responsible for different brain activities, like hearing, seeing, sensing, and moving. The two halves (or hemispheres) are joined together by the corpus callosum, which is a bridge between the right and left sides. It makes sure the two sides can talk to each other and work well together.
- Now let's look a little closer at the right and left brains. The left brain controls all the muscles on the right-hand side of the body and the right brain controls all of the muscles on the left. Our left brain is also responsible for subjects like language, math, and science and likes logic and facts while our right brain enjoys subjects like art and music and is responsible for imagination and creative thinking.
- [SLIDE 4] We can think of the whole brain as being divided into upper and lower brains. The lower brain develops first and is responsible for basic functions like breathing and blinking, quick impulses, and strong emotions like fear and anger. It is also called our reptilian brain or primitive brain. Your upper brain is newer and is still developing and will be for a while longer, until you are in your twenties! It is where more complex mental processes take place like remembering, thinking, planning, and imagining. When our upper brain is working well, we are able to think before we act and be aware of other people's feelings. It is really important for our upper brain to be able to connect to our lower brain so we can make really good decisions. Let's imagine our brain is like bunk beds connected by a ladder. The bottom bunk is the lower brain. It's where we go when we are really scared, sad, or mad. The top bunk is where we go when we want to see things more clearly, do some thinking, imagining, or reflection. Like most bunk beds, the two parts are connected by a ladder. But this ladder only lets us up to the top bunk when we are calm enough.
- [SLIDE 5] In mindfulness, we talk mainly about: the *prefrontal cortex, the hippocampus, and the amygdala.* It is important to learn what these do and how we can take care of them so our brain is balanced and healthy. The prefrontal cortex, or PFC, is located on the top bunk of our brain. It helps us to manage our thoughts and emotions, to make wise choices, and to help us reach our goals. When it's working well, we are able to respond to difficult emotions with positive actions. Sometimes though it is prevented from doing its job by the amygdala. The amygdala is located

on the bottom bunk. It acts as an alarm system for our brain, helping us to respond to danger. It is behind our "flight, fight, or freeze" response.

- This is helpful when we are in true danger and need to respond quickly. Because the amygdala is an ancient part of our brains it can't tell the difference between real danger and stress or strong emotions. So it responds the same way to all perceived threats. Let's say you are walking in the woods and a bear crosses your path. Your amygdala will sound the alarm and set your body into action without you even thinking about it. Your heart rate will increase, you will start to sweat, and blood flow will go to your limbs so you can run away. In this case your amygdala helped you survive. Now, imagine a situation where someone made you really mad. Your body may have felt hot, your heart may have been pounding, and without thinking you yelled something you wish you could take back. In that case your amygdala didn't help you. You see when it is firing it prevents your PFC from helping you to make good decisions. Basically, it kicks over the ladder to the top bunk so you can't climb to your thinking zone.
- The hippocampus stores and recalls memories. When the amygdala is firing, the hippocampus cannot store memories or bring them to mind.
- Mindfulness training helps us to calm the amygdala so our PFC and hippocampus can work better. This will help us to manage our thoughts and emotions, make better choices, feel more relaxed, and improve our mental well-being.

MAKING (55 minutes)

- Have students find their tables by matching student numbers to the centrepieces.

Instructions:

- Introduce the maker project
- First you will see on your table you have… (go through contents of baskets)
- There are two projects for today. First, we want you to work together in your groups to create a life-sized human cutout using the chalk and the brown paper provided. Have one student lie down and another student trace their body. Make sure the heads are turned to one side so that you have somewhere to mount the brains that you will be making. Cut them out and put your Group Letter on the back of the brown paper. We will be mounting them on the cardboard sheets for you!
- The second thing you're going to work on together will be to create a brain for 'your person'. Make sure the size of the brain makes sense because you're going to have to find a way to mount it on the cardboard cutout. Remember that these are the 'people' that you're going to be showing off when we have our Open House at the end of the program. You have all of these materials to work with (Big Reveal – uncover the table!). We will leave the image of the brain up for you, and you can always come to look at the model, but **please feel free to build your person's brain using whatever materials you like. You can label parts or not; you can use different colours or not. The decisions are up to you.** If you have any questions as we go along, raise your hands and one of us will stop by to help.

Tidying: Remember to leave last 5 minutes for students to tidy up their centres.

MINDFUL PRACTICE (5 minutes)

[Gather the students together into one group again, seated on the floor]

Five Senses Exercise: Sometimes we get very upset. We get angry or scared or worried and stressed. In these moments, it can be very helpful to have a tool to use, an exercise, that helps to bring us into the here and now. Something that stops the upsetting thoughts and lets us calm down so we can think clearly again. Some people call this "grounding". Here is a grounding exercise that you can do. It's called "The Five Senses Exercise"

- Right now, look around you and, silently name 5 things you can see at the moment [pause]
- Now silently name 4 things you can hear right now, in this room [pause]
- Now silently name 3 things you can touch or can feel somewhere on your body [pause]
- Now silently name 2 things you can smell right now
- And, finally, name 1 thing you can taste right at this moment

[If time, have students mimic the hand motions to help them remember the exercise, pointing to eyes with 5 fingers held up, ears with 4 held up, etc.]

REFLECTION JOURNALS (10-12 minutes)

Instructions: Reflecting back on everything you have experienced and learned today is a great way for you to process and remember the information that is most important to you. This part of the program is also very important in terms of research because you will be sharing your thoughts and experiences with us. You each have a [yellow] folder with your name and number on it. Pick a spot in the room where you are comfortable and then, on your own, answer the following questions (read through).

You will be handing these journals into your teacher so that she can mark them as part of your literacy work. Please remember, however, that there are absolutely no right or wrong answers here. When you are done, you can hand your folder and your lanyard to one of us, put the pencils back if you borrowed one and then sit quietly [name place] until everyone is done.

HOMEWORK (1-2 minutes)

Thank the students for their time! Tell them you're looking forward to seeing them again next week, and ask them to practise the Five Senses Exercise at least once during the week.

MakerMinds
Session 2
Single Period

Section	Description
Check-in/Review	Get settled and Review Brain Content (from session 1)
Mindful Moving	Mountain pose, sun salutation x 3, half moon, tree pose, mountain pose
Meditation[12]	Guided 1 [relaxation - special place]
Core Content	Thinking about thinking - how many thoughts do we have? How thoughts are connected to physical sensations. Everything passes.
Mindful Practice 1	Drawing 'happy/calm/relaxed' and 'anxious/stressed/worried'
Mindful Practice 2 (catch up from last week)	Five Senses Exercise
Reflection Journals	
Homework	Finish up and ask students to 1) try the 5 Senses Exercise and 2) to pay attention to where in your body you feel your emotions

CHECK-IN/REVIEW (5 minutes)

Hand out lanyards. Review last week. Answer any questions they might have at this point. [SLIDES 2-4]

MINDFUL MOVING (5 minutes)

Mountain pose, sun salutation x 3, half moon, tree pose, mountain pose

MEDITATION (4 minutes)

Guided 1. End with reference to different meditation apps that are available [SLIDE 5]

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[12] Each of the meditations was written by my co-facilitator; they are not included here.

CORE CONTENT (about 5 minutes)

- Last week, we learned about how hard our brains are working all of the time, mostly without us ever being aware of what's going on. Even when we think we are doing nothing, we are still using most of our brain's capacity.
- Think about what you're doing right now. Are you sitting up straight? Is your heart pumping? Are you listening to my voice? Are you breathing and swallowing and seeing what's in front of you? All of these functions only work because our brains are in charge of them. Even without our awareness, they're busy taking care of us...
- But what about the thoughts themselves?
- Let's try something. Let's sit very still for 30 seconds. I'll start my timer, and you just sit as still as you can, either with your eyes closed or gently gazing at a spot on the ground in front of you if you don't want them closed. Try not to think about anything at all. Ready?
- [Discuss - whose brain was silent? Whose brain was a little bit busy? Whose brain was really busy? What sorts of things were you thinking about? Did you have one particular thought that you were following? Were you remembering something about the past? Were you planning or worrying about something in the future? Were you telling yourself a story?]. That's what our brains do.

Let's talk about where we feel those thoughts (6 minutes)

(Go through this slowly)
- **Imagine** [do a mini guided meditation here (eyes closed or averted)... when you arrive in your classroom tomorrow morning, there is a litter of puppies waiting for you and the only thing you have to do all day is play with the puppies....
- Notice how imagining the puppies is making you feel and where do you feel those sensations in your body? Are you feeling anything in your chest or face? Your stomach? Your shoulders? ... (keep answers to themselves...)
- Now think for a moment about something that has happened **to someone else (other than you)** that makes you feel sad. Think about that person for a moment. [Pause]. Notice where you are feeling that sadness in your body. Let me know by holding up a finger if you feel something in your body.
- Now I want you to **remember** a time when you got really angry. Think for a second and then close your eyes or avert your gaze and try to remember that situation clearly. [Pause]. Okay, what is happening in your body now? Notice your face, your shoulders, your chest, your stomach, your hands....
- So when you think about something emotional happening, you experience related physical sensations in your body. Did you notice that we experience emotions in our bodies even when we THINK about memories of the past? It's not happening right now; you're just thinking about it. Or when we think about something happening to someone else? Even when we just IMAGINE emotional experiences that have never happened to us at all, like the puppies, we still feel it in our bodies. This is how powerful our brains are.

MINDFUL PRACTICE (10 minutes)

All of these emotions we just experienced in our bodies we are going to explore further in smaller groups. In a moment, when I say "go", we are going to quietly move into 2 groups. Groups A, B, C are going to go with ___, and D, E, F will come with me.

Materials Needed: brown paper sheets with outlines pre-drawn, different coloured markers, masking tape.

[Have students gather around two sheets of paper, one for a picture of a calm and content person and the other for a picture of a very stressed or worried person. Ask students to help you draw where we feel happiness [facilitators do the drawing; not the students] and where we feel stress]. As you draw, discuss:

- What happens when you read a really good book and you get to a sad part, do you feel it in your body? What about a TV show? A sports event? Etc.
- Empathy: when we understand and share the feelings of others.
- **How does kindness feel?**

CORE CONTENT Part 2 (2 minutes)

- Sometimes when we experience emotions we don't like (and all of the body sensations that go along with them), we feel like we are stuck. When we are really sad, we feel like we are always going to be that sad. When we are stressed or worried, we feel like we are always going to feel that stressed and worried. And that makes it all so much worse, right? Those strong emotions can feel permanent. But let's use our PFC's for a second to think logically and our hippocampus where we store memories to recall the past… have you ever been really sad before? Have you ever been really stressed or angry? And did you stay that way? What happened?
- We like to talk about emotions being like the weather. The weather changes all the time. You can be in the middle of a sunny, happy day, with a bright blue sky overhead, and it can turn stormy. Clouds turn dark and the air grows cold, and it starts to rain. And sometimes it rains really hard and those clouds look like they're going to be there forever. But the rain always stops eventually, the clouds always clear up, and the storm always passes. Big emotions are like that too. They come in and then they go. And it's really okay to feel them. If something makes you sad, then it's okay to feel sad. And if you're angry, it is okay to feel that anger. You can just allow it to be there. But maybe it also helps you in that moment to remember that all of your feelings come and go, even the happy ones. So the sadness will pass. And the anger will pass. The emotions came in just like heavy rain clouds, and they will go away again and your sky will clear up.
- Does that make sense to you?
- Questions?

MINDFUL PRACTICE 2 (5-8 minutes)

[SLIDE 8] Sometimes we get very upset, angry, scared, worried or stressed. These big emotions tend to happen in two different ways.

To understand the first way, it will help us to remember the exercise that we did at the beginning of today's session. We tried to have quiet brains for 30 seconds and we learned that most of the time our brains are busy planning or worrying about the future, remembering the past, or telling us stories. Sometimes one of those thoughts can take over and we get really engaged in it, thinking about it and following it, until we start to feel related physical sensations in our bodies, like tension in our shoulders and jaw, or tightness in our chests, or even sweaty palms. When that happens, we need a way to come back to the present and feel calm again.

The other way big emotions happen is something we learned about last week. Occasionally, we experience a situation that fires up our amygdala when it really doesn't need to be alarmed. When this happens, we need something that will help us calm down the amygdala so we can get out of the bottom bunk, climb up the ladder, and get on that top bunk to use our PFC to think clearly.

In both of these situations, we can use a mindfulness tool to bring us into the current moment, the here and now. Let's use the "The Five Senses Exercise" (see Session 1).

REFLECTION JOURNALS (10-12 minutes)

Instructions:

Please remember to mark the session number and your own MakerMinds ID number on the sheets. Take a pencil if you need one and then find a place in the room where you are comfortable filling out your reflection sheet on your own. If you think of one thing you liked or didn't like, that's okay. If you think of more than one, please write them down! And try to answer "why" you liked or didn't like something about our session today. Your detailed answers are very helpful to us and your teacher will like them too. Please remember there are absolutely no right or wrong answers here. When you are done, you can hand your folder to one of us, put your pencil back if you borrowed one, and then sit quietly [name place] until everyone is done.

HOMEWORK (1-2 minutes)

In the coming week, try to use the Five Senses Exercise at least once and also try to notice where in your body you are feeling your emotions!

MakerMinds
Session 3
Double Period

Section	Description
Check-in/Review	Five Senses and Where in your body did you feel your emotions?
Mindful Moving	Mountain, sun salutations, warrior 1, tree, mountain
Meditation	Focused Breathing 1
Core Content	Introduction to the nervous system How do messages pass between our brains and bodies?
Making	Make some neurons!
Mindful Practice	Square Breathing
Reflection Journals	
Homework	Square Breathing

CHECK-IN/REVIEW (5 minutes)

- Homework: 5 Senses and Body/Emotions
- Our brains are busy in three ways
- Big emotions take over in two ways
- We feel our emotions in our bodies
- Emotions are like the weather

MINDFUL MOVING (3 minutes)

Mountain, sun salutations, warrior 1, tree, mountain

MEDITATION (4 minutes)

Focused Breathing 1

CORE CONTENT (5 minutes)

The Nervous System

- If we touch a hot stove, how do we know to move our hand away? We know because our nervous system carries the message from the tip of our burnt finger to our brain and then sends another message from our brain back to our finger telling us to move it quickly off the hot stove! If we walk past a pile of rotting garbage, why do we react? Our nervous system carries the message of that terrible smell from our nose to our brain and then sends another message from our brain to our hand, telling it to plug our nose! [Can you think of other examples?] So, our nervous system carries messages from different parts of our bodies to our brain and then from our brain to different parts of our bodies. It happens all the time automatically, but we can also make it work on purpose.
- Try this. Ready? Tell your big toe to wiggle. Did you do it? How long did it take between the thought and the wiggle? [PAUSE] I'll tell you! That message travelled from your brain through your nervous system, passing the message in a relay from one neuron to another, all the way to your toe at a speed of up to 150 metres/second! [That's like running from the front of the library to the far edge of park and back in the time it takes you to count three seconds: 1 1000, 2 1000, 3 1000. Imagine that again… That's pretty fast.]
- [SLIDE 7] The nervous system is quite complicated but, put simply, it is made up of three main parts: the brain, the spinal cord that carries the nerves from your brain stem down through the protective bones of your spine, and the nerves that run all throughout your body. All three of these parts contain billions of specialized cells called neurons (or nerve cells). Let's take a closer look at a nerve cell:
- [SLIDE 8] There are different types of neurons. You can see their shapes here but each neuron has the same main parts: thread-like branches called dendrites, a cell body with a nucleus, an axon protected by a layer called the myelin sheath, and axon terminals. [SLIDE 9] Messages are sent from the axon terminals of one neuron to another neuron, where it is picked up by the dendrites. The message then travels through the length of the axon all the way to the axon terminals and there it is sent on to the next neuron until it reaches its target, like a muscle (for example). [SLIDE 10] But you can see there is a gap that the message has to cross. The body uses electrical or chemical signals to carry the message across this gap; and where it does this is called a synapse.

NERVOUS SYSTEM GAME… [5 minutes] [Might have to do this as a presentation rather than game, depending on time]

- That's a lot to take in, so let's try this to help us understand what we've just learned.
- [Half the students line up on one side of the model brain; the other half on the other side. Have them stand arm width apart with arms stretched wide. One hand represents their axon terminals and the other hand represents the dendrites. The space in between represents the synapse. The first student "touches a hot stove"

using a prop (oversized foam hand). This causes PAIN, which is written on a message. Each student on this side of the brain passes the message along his or her own axon to the next "neuron" in the chain, all the way to the brain. Another message, stating "Move your hand!" gets passed from the brain along this new pathway all the way back to the student who touched the stove. That student reads the message out loud and moves the hand away. This game can be played in many ways depending on time].

Come together to calm down (3 deep belly breaths)

MAKING (45-50 minutes)

- Have students find their tables by matching student numbers to the centrepieces.

Instructions:

- Begin with making neurons.
- Students meet their human cutouts for the first time. Decorate? (eyes, hair, mouth)
- Students can finish working on brains as well

Tidying: Remember to leave last 5 minutes for students to tidy up their centres.

MINDFUL PRACTICE (5 minutes)

[Gather the students together into one group again, seated on the floor]

Tying in Mindfulness…

Last week, we talked about how our thoughts and emotions are connected to sensations in the body. Now we know how those messages travel back and forth between the body and the brain. How does knowing about those connections help us?

Let's say my stomach sends a message to my brain saying it feels a bit queasy. And my palms send a message saying they are a bit sweaty. But nothing is happening right now to make me feel this way. Because I know that feelings like this are often connected to my thoughts and emotions, I can do a quick scan of my body and see what else is happening. Does my chest feel a little bit tight? Are my teeth clenched? Are my shoulders up around my neck? [act these out]. They are! So what was I thinking about? When I think about my own thinking, I realize I was reliving a great big argument I had last week with my little brother. And I was so caught up in that memory, that my body had started to react as if we were fighting all over again! These are not helpful thoughts at all and they are making me feel bad. Do you think I can use a mindful tool to **send messages to my body** to let that thought go and calm down?

Okay, but what if something was actually happening to worry me? What if I was about to write a big test at school and I was worried that I might not know any of the answers?

Again, my stomach feels a bit queasy, and my shoulders are up around my neck, and my palms are sweaty. Will it help me to feel this way? Do you think I can use a mindful tool to **send messages to my body** to calm down?

What tools have we used so far that might work? [5 senses; guided meditation; focused breathing meditation]. Great. I'm going to use **Square Breathing ...**

Let's do this together… [SLIDE 11]. Lead students through Square Breathing.

REFLECTION JOURNALS (10 full minutes)

Instructions:

We will hand out your reflection folders. Inside, you will see a sheet marked for Session 2. Please take a pencil if you need one and then find a place in the room where you are comfortable filling out your reflection sheet on your own.

Please remember there are absolutely no right or wrong answers here. When you are done, you can hand your folder to me, put your pencil back if you borrowed one, and then sit quietly [name place] until everyone is done.

HOMEWORK (1-2 minutes)

Practise Square Breathing once or twice this week.

MakerMinds
Session 4
Single Period

Section	Description
Check-in/Review	Square Breathing; Parts of a Neuron
Mindful Moving	Walking Meditation
Meditation	Listening Meditation
Core Content	How to respond vs. react Choosing positive thoughts/5 Good Things Slowing down and paying attention
Mindful Practice	Paying close attention: touch & sight & smell
Reflection Journals	
Homework	5 Good Things & Walking Meditation

CHECK-IN/REVIEW (5 minutes)

- Square Breathing
- The Nervous System: Parts of a Neuron & How Messages Travel

MINDFUL MOVING (4 minutes)

Walking Meditation

MEDITATION (4 minutes)

Listening Meditation

CORE CONTENT (10 minutes)

React versus Respond

- We are learning a lot about connections between the brain and body. The better we get at being aware of what our brains and bodies are doing, the better we will get at being able to manage our emotions and our behaviours. To help you understand this idea, we have two super short stories for you:

- The first one is about Fred. This is Fred [SLIDE 9]. Fred's parents just told him that he can't have any screen time today because he didn't clean his room [SLIDE 10]. This is NOT good news for Fred. He feels a rush of anger. [SLIDE 11] His face gets hot. His chest feels heavy. His shoulders are up and his palms are sweating. Fred is about to REACT. He wants to shout angry things at his parents. He wants to storm off to his room and slam the door. But Fred knows a thing or two about being mindful [SLIDE 12]. He knows what's going on in his brain and body right now. He knows that his amygdala is firing and it's stopping his PFC from working properly. He knows he is stuck on that bottom bunk bed and that he needs to get to the top bunk to think clearly. To do that, he has to calm down a bit. So what does Fred do? [SLIDE 13] He takes a deep breath and goes to his room. He chooses to do a quick '5 senses' exercise. He looks around his room and counts five things he can see. He counts four things he can hear. He counts three things he can touch and two he can smell (one of them is his dog and the other is his laundry basket). Finally, he counts one thing he can taste (which is old bubblegum). By the time he's done this exercise, he feels a lot calmer [SLIDE 14]. He's still a little bit upset but his shoulders are relaxed, his face is no longer hot, and his palms are dry. Now he can use his PFC to figure out how to RESPOND to his parents. [SLIDE 15] He goes back to his parents and apologizes for not cleaning his room. He says he will do it right away and he'll tidy the bathroom too. He asks, if he does that, could he please still have TV before bed? [SLIDE 16] His parents are pretty impressed. Fred has done a really good job of RESPONDING to his situation instead of just REACTING to it without thinking. [SLIDE 17] They say "yes" and Fred starts cleaning....
- [Discuss] What do you think would have happened if Fred had reacted to losing his screen time? What was he going to do? How did he know that he had to calm down? How else could he have calmed himself down? How else could he have responded?

Story #2

- [SLIDE 18] This is Freda. Freda's really good friend hasn't paid much attention to her today [SLIDE 19]. When Freda asked her to play at first break, she said "I can't" and walked quickly away. Freda feels like something is wrong with her friend and that maybe it is because of something she's done. [SLIDE 20] Freda knows that she is feeling hurt and sad and that she's feeling it in her body too. She has these little pangs in her chest when she thinks about her friend, her throat is clenched, her forehead is scrunched up, and her stomach is a little queasy. When her friend walked off at the beginning of first break, Freda wanted to REACT. [SLIDE 21] She wanted to say "something mean" because she wanted her friend to feel hurt too. But Freda knows a thing or two about being mindful [SLIDE 22]. She's aware of what's going on in her brain and body right now. And she knows that she will feel a little bit better if she sits outside by herself for a little while. At recess, she does just that [SLIDE 23]. She focuses on her breath and leads herself through a little guided meditation. She pictures herself letting the bad feelings go until her stomach starts to feel better and her throat loosens. Now Freda is calm enough to use her PFC to figure out how to RESPOND. [SLIDE 24] So, when the bell rings, Freda finds her friend and explains that she has been feeling left out all day and that it is making her

worried and sad. Her friend is very surprised! [SLIDE 25] She reminds Freda that her big dance performance is that night and she is too nervous to even talk about it. Freda had forgotten all about the show, and now she's really glad that she wasn't mean to her friend! [SLIDE 26] The two girls walk home together after school and both of them feel better.

- [Discuss] What do you think might have happened if Freda had REACTED and said something mean to her friend instead of RESPONDING by explaining her feelings? How did Freda know that she needed to calm down to think clearly? What else could Freda have done to calm down? What do you think is the difference between RESPONDING and REACTING?

- [Summarize] Both Fred and Freda were being mindful of their physical feelings, their thoughts, and their emotions. Both of them chose to RESPOND to a situation instead of just REACTING to it. When we react to something that happens to us, we do it without pausing to think clearly and make good choices about what to do. It's like being mind-**less** instead of mind-**ful**. And when we react in the middle of big emotions — like anger or sadness or worry — then we can make big mistakes with our behaviour that cause trouble for us and others around us.

- [Pause here to answer questions or discuss similar situations, if time]

MINDFUL PRACTICE 1 (10 minutes)

An important part of what we are learning to do in this mindfulness program is to pay close attention to our minds and bodies (like Fred and Freda) but also to the world around us. So now we are going to try something that will help us to practise paying attention using our senses.

[Ask students to split into two groups (ABC and DEF) one with each facilitator. Move so that we are sitting in two separate circles on the floor]

- Introduce the idea that we can get a lot of pleasure out of life if we stay present in this moment, the here and now. If we're always rushing about with our minds on something else, we miss out on so much of what this amazing world offers us (provide personal example?).

- We can slow down a little bit, do just one thing at a time, and let go of (1) thoughts of the future and (2) thoughts of the past and (3) imagined stories, and instead, pay close attention to what's right in front of us. As we pass the 'sensory stimulant' around the circle, ask the students to consider it closely. What do they feel, or see, or smell? What feelings come up?

[Approximately 5 minutes, then groups switch between facilitators]

[INSERT SOME STRETCHING IN BETWEEN]

MINDFUL PRACTICE 2 (5 minutes)

A great way to make sure we are paying attention to the good things in life is to think about those good things right before we go to sleep. Even on the hardest of days, we can still find positive things to focus our minds on. And if we do this right before we go to sleep, we tend to fall asleep feeling better and wake up feeling better too. It's a wonderful way to build positivity into our lives.

[SLIDE 27] Try this with me now: close your eyes and, silently to yourself, name five good things that you've experienced already today. These could be things you have seen or heard, or things that have happened to you, things someone has said to you or done for you, things you have done for someone else, or even things about the world that you've read. As you're making this list in your head, notice how your body feels. Maybe thinking about good things makes you feel good too? Maybe it makes your shoulders loosen and your chest lighten. Maybe it makes you smile or your head feel like it's floating. Maybe you get a tingly sensation in the back of your neck or butterflies in your belly. Keep making your list until you reach five things and if you've already reached five, you can keep going and count even more...

Okay, open your eyes. Does anyone want to share something from their list? [Discuss]

So that was a mindful tool that we call '**Five Good Things'** and it's a great one to do right before you go to sleep.

REFLECTION JOURNALS (10 full minutes)

Instructions:

We will hand out your reflection folders. Inside, you will see a blank worksheet, please put the session number on the top and your MakerMinds ID# on the top right. Please take a pencil if you need one and then find a place in the room where you are comfortable filling out your reflection sheet on your own.

Remember that you are handing these into your teacher so that she can read them and mark them as part of your literacy work BUT there are absolutely no right or wrong answers here. When you are done, you can hand your folder to me, put your pencil back if you borrowed one, and then sit quietly [name place] until everyone is done.

HOMEWORK (1-2 minutes)

5 Good Things & Walking Meditation

MakerMinds
Session 5
Double Period

Section	Description
Check-in/Review	5 Good Things; Mindful Walking; Respond vs. React; Paying Close Attention
Mindful Moving	*Removed to allow time for making...*
Meditation	Guided Breathing 2 - label thoughts and let them go...
Core Content	Quick review of nervous system Vagus nerve What happens to our bodies in fight/flight and rest/digest
Making	Spinal cord and nervous system
Mindful Practice	Full Belly Breathing
Reflection Journals	
Homework	Full Belly Breathing

CHECK-IN/REVIEW (5 minutes)

- 5 Good Things Before Bed (do this together) & Mindful Walking
- Responding vs. Reacting (Fred and Freda)

MEDITATION (4 minutes)

- Guided 2 - Leaves on the stream

CORE CONTENT (10 minutes)

- We've learned a lot so far about our brains and our nervous system, and we've spent some time making the connection between what's happening in our brains and how it feels in our bodies. So, for example, if you were facing a stressful situation — like having to perform at a school assembly — maybe your stomach would hurt. We get that connection is there, but why does it happen?
- [SLIDE 5] We know the nervous system is pretty complicated, but the main parts are the Brain, the Spinal Cord that travels down your spine, and the nerves that run throughout your body. Today, we are going to talk about two parts of the system that are related to mindfulness. [SLIDE 6] We have a Fight/Flight/Freeze system

(also called Sympathetic) and a Rest/Digest system (also called Parasympathetic). These two systems are both part of our overall nervous system. They have both evolved to help us survive but they have opposite jobs to do in the body.

- Let's talk about the Fight/Flight/Freeze system first. [SLIDE 7] Do you remember when we talked about a bear chasing us in the woods? If that happened, our amygdala would fire and set off the fight/flight/freeze part of our nervous system (the sympathetic part of our nervous system). We call it that because it makes us do one of three things to survive. We stand and fight; we run away really fast (that's the flight part) or we freeze so that whatever is after us doesn't see us. So, what does it feel like when this system is at work? [SLIDE 8]

- Your blood pressure would go way up and your heart would pound in your chest because the heart needs to pump blood quickly to your limbs so you can run! [SLIDE 9]. If you were standing still, this sudden change might make you feel dizzy, or give you a headache, and you would definitely feel your heart pounding, you might even feel short of breath. [SLIDE 10] You would get sweaty as well and this would happen on purpose so that the bear couldn't hold onto you, so that you could slip out of its grasp. If you were standing still and this happened, you might be aware of sweaty palms or sweat under your arms. [SLIDE 11] Muscles would tighten to help you move quickly, which you would feel all over, like in your shoulders and hands and the back of your neck. [SLIDE 12] Blood would rush away from your core towards your limbs so that you could run fast and it would also protect your vital organs. But that blood rushing away from your core might also feel like a stomach-ache and it could make your hands and feet feel tingly.

- So you can see that all these things happen to help us survive a real threat to our lives, and we can be thankful our bodies are this amazing and protective of us. But when that amygdala fires and the situation isn't actually threatening, then all of those effects in our bodies can feel pretty bad.

- The other part of the nervous system that is related to mindfulness is the Rest/Digest system (also called the Parasympathetic system) [SLIDE 13]. When we are relaxed, our body is able to do all the things it has to do to heal & repair itself, grow, fight off infections, process food for energy, and defend us from potential harm [SLIDE 14]. When this system is at work, our breathing is easy, our heart rate is normal, our muscles are loose, and we feel calm, even calm enough to be able to sleep well.

- One of the major parts of this Parasympathetic system is the vagus nerve [SLIDE 15] This nerve is like a highway between your brain and your heart, lungs, and gut or digestive tract. Just like on a highway, the traffic is going both ways. So your brain is sending out messages along the vagus nerve and your organs are sending messages back along the same nerve. When we exercise that vagus nerve, we can keep it in good shape to help it support the Rest and Digest functions.

- Now that we understand the effects that happen when the Fight/Flight/Freeze system is at work, you might be better able to recognize when you need to use a mindfulness tool to calm your amygdala and try to get your body into the Rest/Digest mode because when that part of the nervous system is working, that's when we are really taking care of our bodies.

MAKING (45 minutes)

[SLIDE 16]

- Spinal Cord/Spine and Nervous system
- Continue decorating Buddy, consider labelling different parts
- Make sure brains are attached

MINDFUL PRACTICE (5 minutes)

- Full Belly Breathing (with a little humming thrown in)

REFLECTION JOURNALS (10 full minutes)

Instructions:

We will hand out your reflection folders. Please take a pencil if you need one and then find a place in the room where you are comfortable filling out your reflection sheet on your own.

Please remember there are absolutely no right or wrong answers here. When you are done, you can hand your folder to me, put your pencil back if you borrowed one, and then sit quietly [name place] until everyone is done.

HOMEWORK (1-2 minutes) - Full Belly Breathing

MakerMinds
Session 6
Single Period

Section	Description
Check-in	Full Belly Breathing
Mindful Moving	Vagus nerve breathing
Meditation	Guided Meditation 3
Core Content	Mindful Words: kindness to ourselves & others Introduction to electrical circuits
Mindful Practice	Finger Breathing
Reflection Journals	
Homework	Finger Breathing

CHECK-IN/REVIEW (5 minutes)

- Rest/Digest and Fight/Flight/Freeze
- Full Belly Breathing

MINDFUL MOVING (4 minutes)

Vagus nerve breathing

MEDITATION (4 minutes)

Guided Meditation 3

CORE CONTENT (5 minutes)

- Do you remember when we worked in groups to draw pictures of where we feel different emotions in our bodies? They looked like this: [SLIDE 7]. At the very end of that activity, we talked briefly about what kindness feels like and, today, we want to return to that idea and explore it a little bit more.
- Throughout this program, we have talked a lot about being aware of our thoughts and related physical sensations in our bodies, and we have practised different meditations that encourage that awareness like the body scan and Sitting by the Stream watching leaves…. Now we know that being mindfully aware of our thoughts and emotions gives us power to make choices about what we do. Are we going to let

a thought take over or just let it go? Are we going to act out during BIG emotions or calm ourselves down? Are we going to REACT in a situation without thinking or are we going to RESPOND instead?

- We can use this same mindful awareness to make choices about the words that we use as well.
- Let's try this. Close your eyes if you are comfortable doing that or just gaze at a spot on the floor in front of you. Now bring to mind something you like about yourself, a compliment you might give yourself. No one else will know what it is that you're thinking. Think of something you really like about who you are and use it to finish this phrase: "I am _____". Say that phrase silently to yourself, slowly, three or four times in a row. Does that make you feel good? Do those words make you want to smile a little bit? Maybe you feel a little bit of lightness in your head or chest? Now open your eyes. The words you choose to say to yourself have power. They impact how you feel, so it's important to be aware of the words you direct at yourself and choose them carefully. This is a good way to be kind to yourself.
- Let's explore that idea of kindness some more.
- Once again, close your eyes if you are comfortable doing that or just gaze at a spot on the floor in front of you. Bring to mind a memory you have of when you were kind to someone. It could be something kind you did or something kind that you said. That someone could be a family member, a friend, a teacher, or even a stranger. Pause here for a second and think about that moment [pause]. Try to call the details to mind. Think about why you were kind [pause]. Think about how being kind felt [pause]. Now think about how your act of kindness might have felt to that other person [pause]. Okay, open your eyes. When we do or say something kind for others, what does that feel like? (let students answer).
- These answers you're giving me sound similar to the answers you gave for happiness [SLIDE 8]. Why do you think that is? Maybe we can conclude that being kind to others is good for others, obviously, but it is also a really good source of happiness for ourselves too.
- Here's a little experiment you can try. The next time you feel a little bit down, try doing something unexpectedly kind for someone else - a classmate, a family member, your teacher, or a friend. Sometimes a really easy way to lift our own spirits is by making someone else feel good.
- One last thing before we move on today…. You have learned a great deal about the connections between your own thoughts, emotions, and physical sensations. And you have also learned about different tools you can use to make yourself feel better. So how can you use what you have learned about mindfulness to help other people around you? [DISCUSS]

INTRODUCTION TO ELECTRICAL CIRCUITS

- Your "buddies" look amazing so far and it has been really exciting for us to watch you use your creativity and your understanding of everything we have learned to build models of all of the different parts of the nervous system. Next week we are going to add an extra special element to your buddies. But before we do this, we are going to need to talk about building Simple Electrical Circuits because you will use

this knowledge to add working lights to your buddies! Each group is going to add at least one light to their buddies and, if you have time, you can add two.

- So let's talk about how simple electrical circuits work! [SLIDE 10] The first thing you need to understand is that an electrical circuit has to have a source of electrical energy (like a battery); it has to have a load (like a lightbulb, an LED, a motor, etc.), and a means of conducting electricity in a loop (like wires). We are going to be working with 3V batteries, 18-gauge wires, and LED bulbs.
- The other very important thing you need to understand is that electricity <u>always</u> flows in a loop and a loop has to be complete for an electrical circuit to work. If the loop is broken at any point, then we say that the circuit is "open" and it can't work. The electricity can't jump over any gaps. [SLIDE 11] So the battery has to be connected to a wire that connects to the load (or light) that connects to another wire that connects back to the battery. Once that loop is complete (or "closed") then the electricity flows from one side of the battery through the light and back to the other side of the battery. As long as everything is connected, then the electricity will flow and the light will be on.
- In a moment, I'm going to ask all of you to go to your tables. On the table, you will find a labelled bag containing all of these things: [SLIDE 12]. You will also find some laminated diagrams. I'm going to ask that you don't touch anything at all until I give you clear instructions. All of the things in that bag are quite delicate and can break easily so you're going to have to listen to me very carefully. I also want you to remember that we are thinking about kindness today, so I'm going to ask that you watch out for your fellow group members, that you make sure everyone gets a chance to make circuits, that you listen to each other and that you help each other to learn.

[Have students move to the tables and lead them through three steps: 1) battery + LED; 2) Simple Circuit #1; 3) Simple Circuit #2]

Step 1
- Students each choose a battery and an LED, attach and watch it light up. Explain why it happens and why some of them didn't work.

Step 2
- [SLIDE 13 - show diagram] Here is a diagram of a simple circuit. There are enough of these diagrams on each table so that everyone can try this. Take a diagram and use it as your guide while you listen to my instructions. You start with a source of electrical energy (a battery), see that the battery has a positive side and a negative side. Now, place the LED where it goes on the chart. See that it has a long leg, that's the positive one, and a short leg, that's the negative one. Now you will need two wires from the bundle. You need to run wires from one part to the next so that the electricity can travel in a loop (or circuit). Connect the positive side of the battery to the positive leg of the LED (you might want to use a piece of scotch tape to hold things in place. Now connect the negative leg of the LED to the negative side of the battery. Does the light turn on? If it does, then you've done it right. If not, then something isn't connected properly…

Simple Circuit #1

This end of the wire
goes under the battery.
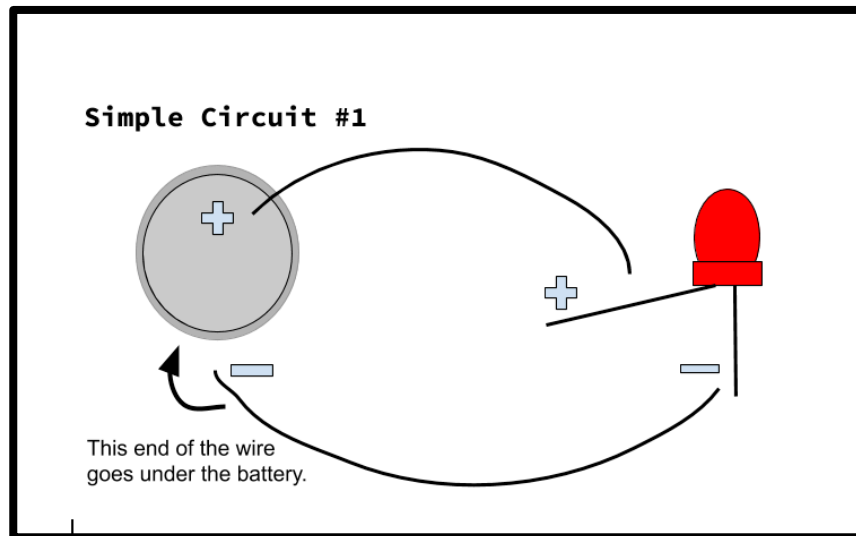
Step 3

- [SLIDE 14 - see diagram]. Now that we know how to make a simple circuit work, we can add a switch to our circuit so that we can turn the lights on and off whenever we want! With the kinds of switches we will be using, pressing the button closes the switch and completes the circuit. Letting go of the button opens the switch and breaks the circuit. So, most of the time, the loop is NOT complete (the circuit is broken) and the light is off. When you want to turn the light on, you press the button which closes the loop (completes the circuit) and the light turns ON.

Simple Circuit #2

This end of
the wire goes
under the
battery.
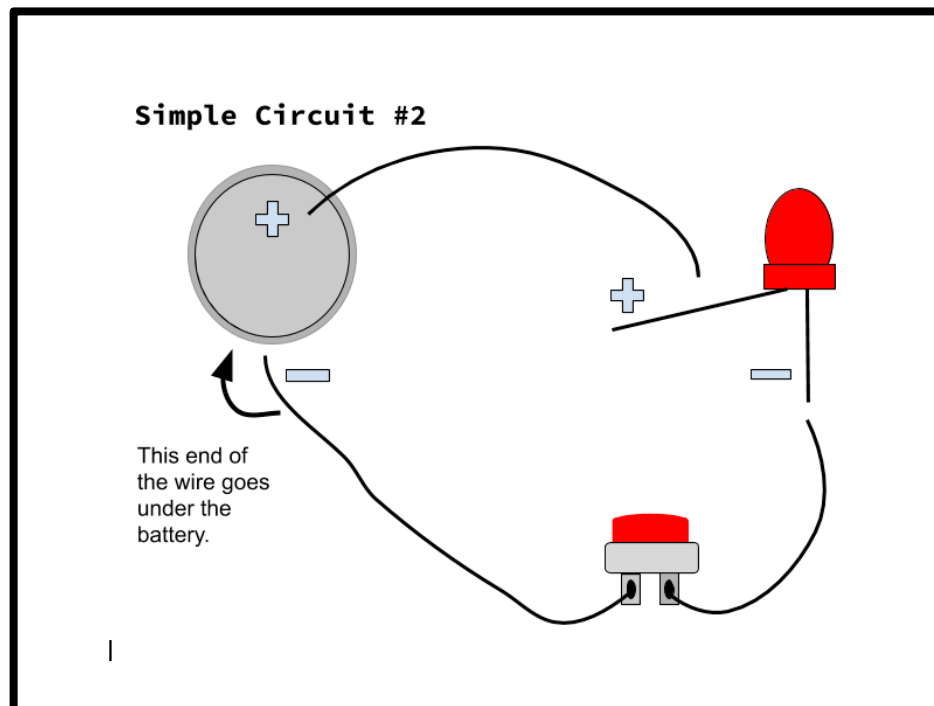
- There are two diagrams at each table and two switches in the bag so that you can groups of two or three to try this.
- [Guide them through the diagram]
- Congratulations! Now you know how to make a simple electrical circuit with a switch and, next week, we will be finishing up our buddies by adding lights!

MINDFUL PRACTICE (5 minutes)

[Gather the students together into one group again, seated on the floor in front of the screen. **Five finger breathing**…] [SLIDE 15]

REFLECTION JOURNALS (15 minutes)

Instructions:

We will hand out your reflection folders. Inside, you will see a blank worksheet, please put Session #6 on the top and your MakerMinds ID# on the top right. Please take a pencil if you need one and then find a place in the room where you are comfortable filling out your reflection sheet on your own.

Remember that you are handing these into your teacher so that she can read them and mark them as part of your literacy work BUT there are absolutely no right or wrong answers here. When you are done, you can hand your folder to me, put your pencil back if you borrowed one, and then sit quietly [name place] until everyone is

HOMEWORK (1-2 minutes) - **Five finger breathing**

MakerMinds
Session 7
Double Period

Section	Description
Check-in/Review	Finger Breathing
Mindful Moving	Removed to save time!
Meditation	Special Place
Core Content	REVIEW
Making	Adding electrical circuits… Finishing up/labels/decorating
Mindful Practice	Instead, discuss what will happen at the Open House
Reflection Journals	
Homework	None!

CHECK-IN/REVIEW (5 minutes)

- Finger Breathing

MEDITATION (4 minutes)

- Special Place

CORE CONTENT (6-8 minutes)

- **MakerMinds Review - Fred's Story** (4-5 minutes). As a class, work together to have students help fill in the blanks on a story about Fred that covers/reviews key topics from the entire program. [SLIDE 3]
- Take up the answers … [SLIDE 4]

- **What's in Your Toolbox?** (2-3 minutes). Begin by asking students to recall all the tools they have learned to use. Then go through slides to review them together [SLIDE 5&6].

MAKING (45-50 minutes)

Show students MakerMinds video explaining how to add lights to cardboard. Make sure students understand that they are to add one light to their buddies and that they should be able to explain why the light is there (how it's connected to what we have learned about mindfulness). If time, they can add two. [SLIDE 7]

- Adding electrical circuits
- Attaching everything
- Adding labels
- Finishing touches

MINDFUL PRACTICE (5 -10 minutes)

- Gather students in front of the screen again.
- Square Breathing to calm down….
- [SLIDE 8] Go over timing of Open House
- [Start Discussion] What can we discuss with our visitors?

Some potential answers:

- Point out the different body parts you made and talk about how they are connected to mindfulness
- Take visitors to the Make a Neuron Table, to see the pictures we drew of emotions, to see the toolbox of mindfulness tools, to look at the brain model on the welcome table, and to watch the slide show.

REFLECTION JOURNALS (10 minutes)

Please take a pencil if you need one and then find a place in the room where you are comfortable filling out your reflection sheet on your own.

Remember that there are absolutely no right or wrong answers here. When you are done, you can hand your folder to me, put your pencil back if you borrowed one, and then sit quietly [name place] until everyone is ready to go.

HOMEWORK (1-2 minutes) - No homework. Prepare for final session (#8) which will be the Open House!

Appendix B:

Post-Program Interview Questions for Student-Participants

To be conducted individually following the final session of the program. Questions will be selected from amongst the following:

1. Tell me something about the program that really stands out in your memory.
2. What was your favourite thing to make? Why?
3. We had two different kinds of days in the past eight weeks. On some days, we learned about mindfulness. On other days, we learned about mindfulness and we also made models. Some students preferred the 'making' days and some preferred the 'non-making' days. Which day did you prefer? Why?

   a. Which of these two types of days was the most interesting? Why?
   b. On which of these two types of days did you feel like you learned the most? Why?
   c. Did you feel like you were able to be more attentive on 'making' days or 'non-making' days? Why?
   d. Are there any other differences you want to tell me about between the two types of days?

4. On the days when we made things, did you ever find yourself getting frustrated? Please tell me what you did when this happened.
5. Did you make any mistakes when you were making something? What happened? How did you fix it?
6. Please tell me something you learned about mindfulness. Why do you think you remember that?
7. Think about when you were making a model. Was it helpful or not helpful to be working in a group. Why?
8. Was it ever difficult to work with other students? What helped you to get through that?
9. Have you used any mindfulness tools outside of school? Please explain.
10. Now that you have completed the program, are there situations that you might handle differently in the future? Please explain.

Appendix C:

Student Reflection Journal Template

Session Number _____

What thing(s) did you like about today?

What thing(s) did you <u>not</u> like about today?

Tell me something you learned about yourself.

Tell me about any time(s) that you used a mindfulness tool this past week.

Appendix D:

Criteria for Theme of the 'Enthusiasts'

	Cam	Cecilia	Esther	Hannah	Isaac	Kai	Kristin	Marie	Max	Nadia	Noelle	Stefie	Tyler
Verbal Participation in Class *(1 point maximum)*	xxx xx	xx	xxx xxx xx	xx	xxx xxx xxx	xxx xxx	xxx xxx	xx	xxx xxx x	xxx		xxx xxx xxx	
Eager in Mindfulness *(1 point per example)*	x				x				xx	x		x	x
Leadership *(1 point per example)*	xxx		x		x		x	x	xx	x	xxx		
Confidence *(1 point per example)*		x	x	x		x		x		xx	x	xxx	x
Controlling *(1 point per example)*		x		xx	x	x	x	x			x	x	x
Uptake of Mindful Tools (by Session) *(1 point if early)*	3	2	2	3	4	3	3	3	2	3	6	3	3
POINT TOTALS	6	4	4	5	5	4	4	5	4	7	5	7	4

Appendix E:

**Responses to Positive and Negative Prompts
in Enthusiasts' Reflection Journals**

	Prompt	**Session 1**	**Session 2**	**Session 3**	**Session 4**	**Session 5**	**Session 6**	**Session 7**	**Totals**
Cam	Positive	+	+	+	+	+	+	+	7+
	Negative	-	+	+		+	+	+	1- (5+)
Cecilia	Positive	+	+	+	+	+	+	+	7+
	Negative	+	+	+	-	-	+	+	2- (5+)
Esther	Positive	+	+	+	Absent for Journals	+	Absent	+	5+
	Negative	+	-	-	Absent for Journals	-	Absent	-	4- (1+)
Hannah	Positive	None	+	+	+	+	+	+	6+
	Negative	None	+	+		-	+	+	1- (4+)
Isaac	Positive	+	+	+	+	+	+	+	7 +
	Negative	-	+	+	+	+	+	+	1- (6+)
Kai	Positive	+	+	+	+	+	+	+	7 +
	Negative	+	-	+	+	-	+	+	2- (5+)
Kristin	Positive	+	Absent	+	+	+	+	+	6+
	Negative	-	Absent	-	-	+	+	+	3- (3+)

Appendix E:

**Responses to Positive and Negative Prompts
in Enthusiasts' Reflection Journals (cont'd)**

	Prompt	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Totals
Marie	Positive	+	+	+	+	+	+	+	7+
	Negative	-		+	+	+	+	+	1- (5+)
Max	Positive	+	+	+	+	+	-	+	6+ (1-)
	Negative	+	+	+	+	+	+	-	1- (6+)
Nadia	Positive	+	+	+	+	+	+	+	7 +
	Negative	-	-	-	-	-	-	-	7-
Noelle	Positive	+	+	+	+	Absent	+	+	6+
	Negative	+	+	+	-	Absent	-	-	3- (3+)
Stefie	Positive	+	+	+	+	+	+	+	7 +
	Negative	+	-	+	+	+	+	-	2- (5+)
Tyler	Positive	+	+	+	+	+	+	+	7+
	Negative	-		-	+	-	+	+	3- (3+)
Totals	85/87 positive answers to positive prompt = 98%; a further 51 positive answers to negative prompt = 136/87 = 156%; 31/87 negative answers to negative prompt = 36%; an additional negative response to positive prompt = 37%								

Appendix F:

Enthusiasts' Use of Mindfulness

(Responses in Student Reflection Journals indicating use of mindfulness in the past week)

Session	1	2	3	4	5	6	7
Student		Cecilia, Esther, Max	Cam, Cecilia, Esther, Hannah, Kai, Kristin, Marie, Max Nadia, Stefie, Tyler	Cam, Cecilia, Hannah, Isaac, Kristin, Marie, Max Nadia, Stefie, Tyler	Cam, Cecilia, Esther, Hannah, Isaac, Kai, Kristin, Marie, Max Nadia, Noelle, Stefie, Tyler	Cam, Hannah, Kristin Marie, Nadia, Noelle, Stefie, Tyler	Cam, Cecilia, Esther, Marie, Hannah, Isaac, Kai, Max Nadia, Noelle, Stefie, Tyler
Count	0	3	11	10	13	8	12

Appendix G:

Criteria for Theme of the 'Reticents'

	Braelyn	**Carmella**	**Liam**	**Maya**
Overlooked/Quiet *(1 point per example)*	xx	x	xxx	x
Prefers Instructions *(1 point per example)*	xx	x		
Passive Role in Making *(1 point per example)*	xx	xxx	xx	xxxx
Confidence through Circuitry *(1 point per example)*	x	x	xx	xxxxx
POINT TOTALS	7	6	7	10

Appendix H:

**Responses to Positive and Negative Prompts
in Reticents' Reflection Journals**

	Prompt	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Totals
Braelyn	Positive	+	+	+	+	+	+	+	7+
	Negative	+	+	+	+	+	+	+	(7+)
Carmella	Positive	+	+	+	+	+	+	+	7+
	Negative	-	-	+	-	-	-	-	6- (1+)
Liam	Positive	+	+	+	+	+	+	+	7+
	Negative	-	+	+	+	+	+	+	1- (6+)
Maya	Positive	+	Absent	+	+	+	+	+	6+
	Negative	-	Absent	-	-	-	+	+	4- (2+)
Totals	27/27 positive responses = 100%; an additional 16 positive responses to the negative prompt = 43/27 = 159%; 11/27 negative answers to negative prompt = 41%								

Appendix I:

Reticents' Use of Mindfulness

(Responses in Student Reflection Journals indicating use of mindfulness in the past week)

Session	1	2	3	4	5	6	7
Student		Liam	Carmella, Liam	Carmella, Liam	Carmella, Liam	Braelyn, Carmella, Liam, Maya	Braelyn, Carmella, Liam
Count	0	1	2	2	2	4	3

Appendix J:

Criteria for Theme of the 'Distracted'

	Jacob	**Mason**	**Nick**
Excluded by Others *(1 point per example)*	xxx	x	x
Disengaged/Off Task *(1 point per example)*	x	xxxxxxx	xxxxx
Looking to Others for Directions in Making *(1 point per example)*	xx	xxxx	xxx
Distracting Behaviour *(1 point per example)*	xxx	xxx	x
POINT TOTALS	9	15	10

Appendix K:

**Responses to Positive and Negative Prompts
in Distracted Students' Reflection Journals**

	Prompt	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Totals
Jacob	Positive	+	+	+	+	+	+	+	7+
	Negative	+	+	+	+	-	+	+	1- (6+)
Mason	Positive	+	+	+	Absent	+	+	+	6+
	Negative	-	-	+	Absent	+	+	+	2- (4+)
Nick	Positive	+	Absent	+	+	+	+	+	6+
	Negative	-	Absent			+	+		1- (2+)
Totals	19/19 positive responses to the positive prompt = 100%; a further 12 positive responses to the negative prompt = 31/19 = 163%; 4/19 negative responses to the negative prompt = 21%								

Appendix L:

Distracted Students' Use of Mindfulness

(Responses in Student Reflection Journals indicating use of mindfulness in the past week)

Session	1	2	3	4	5	6	7
Student			Jacob	Jacob	Jacob, Nick	Jacob, Mason, Nick	Jacob, Mason, Nick
Count	0	0	1	1	2	3	3

Appendix M:

Criteria for Theme of the 'Builders'

	Ethan	**Joseph**	**Michael**
Distracted *(1 point per example)*	xx	x	xxx
Disinterested in Mindfulness *(1 point per example)*		xxxx	
Deeply Interested in Making *(1 point per example)*	xxxx	xxx	xxxx
Inhibited by Others in Making *(1 point per example)*		xxx	xx
Prowess in Circuitry *(1 point per example)*	xxxxxx	xxxxxxxx	xxxxx
Uptake of Mindful Tools (by Session) *(1 point if late)*	5	6	5
POINT TOTALS	13	20	15

Appendix N:

**Responses to Positive and Negative Prompts
in Builders' Reflection Journals**

	Prompt	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Totals
Ethan	Positive	+	Absent	Absent	-	+	+	+	4+ (1-)
	Negative	-	Absent	Absent	+	-	+	-	3- (2+)
Joseph	Positive	+	+	+	+	+	+	+	7+
	Negative	-	-	+	-	+	-	+	4- (3+)
Michael	Positive	+	+	Absent	+	+	+	+	6+
	Negative	+	+	Absent	+	+	+	+	(6+)
Totals	17/18 positive responses to the positive prompt = 94%; a further 11 positive responses to the negative prompt = 28/18 = 155%; 7/18 negative responses to the negative prompt = 39%; an additional negative response to positive prompt = 8/18 = 44%								

Appendix O:

Builders' Use of Mindfulness

(Responses in Student Reflection Journals indicating use of mindfulness in the past week)

Session	1	2	3	4	5	6	7
Student					Ethan, Michael	Ethan, Joseph, Michael	Ethan, Joseph
Count	0	0	0	0	2	3	2