“CAUSE YOU DON’T REALLY NEED A TEACHER TO LEARN STUFF”: THEORIZING A ‘LANES OF LEARNING’ MODEL OF INFORMAL, SELF-DIRECTED LEARNING

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Kyle Robert Vareberg

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"Cause you really don't need a teacher to learn stuff": Theorizing a 'Lanes of Learning' Model of Informal, Self-Directed Learning

By

Kyle Robert Vareberg

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DOCTOR OF PHILOSOPHY

SUPERVISORY COMMITTEE:

Dr. Carrie Anne Platt
Chair

Dr. David Westerman

Dr. Melissa Vosen Callens

Dr. Brent Hill

Approved:

6 – 30 – 2021
Date

Dr. Stephenson Beck
Department Chair

ABSTRACT

In this dissertation, I explore how self-directed learners assess their learning in informal contexts. Self-directed learners experience high intrinsic motivation and learner control, so studying these learners' experiences provides valuable insights into learning. I pose four questions: 1) How do self-directed learners in informal contexts satisfy their need for a) autonomy, b) relatedness, c) competence, and d) prioritize the satisfaction of these needs? 2) How do self-directed learners in informal contexts self-regulate their learning? 3) What affordances are perceived by informal learners during self-directed learning? 4) What relationships exist between the satisfaction of learners' basic needs, self-regulation, and perceived affordances during self-directed, informal learning? I employ multiple methodologies, including interviews (N = 19) and an open-ended survey (N = 154), and based on this evidence, theorize a Lanes of Learning model to explain how learners regulate learning, assess competence, involve others, and use tools to meet their needs. Evidence shows learners in 1) Lane A prefer efficiency, collect confirming cues, involve others to meet a goal, and use tools that provide a set of correct steps; 2) Lane B prefer structure, collect confirming cues and add affirming cues, involve others for functional purposes, and used tool that resemble the *real thing*; 3) Lane C prefer depth and chase information as it becomes relevant, collect affirming cues, involve others for emotional reasons, and use tools that provides more information to chase; and, 4) Lane D prefer innovation, collect affirming cues and add confirming cues, involve others to build a network, and use tools that are inspirational, not educational. I argue people are motivated to learn when learning is on their terms, and this motivation manifests in the strategies and processes taken by individuals during learning.

Keywords: *Lanes of Learning; self-directed learning; informal learning; perceived affordances; self-determination theory; motivation; self-regulation*

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DEDICATION

To DAD, the man who taught me the value of hard work.

02/25/48 - 08/25/20

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LIST OF ABBREVIATIONS

SDL .....self-directed learning

ICT .....information and communication technology

SDT .....Self-Determination Theory

ZPD .....Zone of Proximal Development

CMC.....computer-mediated communication

SIP.....social information processing

SRL .....self-regulated learning

MMR.....mixed methods research

LOL.....Lanes of Learning

DI .....Differentiated Instruction

CHAPTER 1: INTRODUCTION

The COVID-19 pandemic gifted me, and others, a long-sought luxury – *time.* In many cases, what people did with this time was documented using social media. For example, I have a Facebook friend who posted weekly videos of her 11-year-old son actively learning to cook. Coincidentally, this video was juxtaposed with the laments of a buddy of mine, a 1st-grade teacher who was learning to teach 6-year-olds from a distance. He was not alone. When students, parents, teachers, and administrators from learning institutions, ranging from small-town preschools to our nation's Ivy Leagues, were thrust into all-digital learning environments, they had to learn not only the content for several courses but also the software specifications unique to the technologies. Parents learned to be teachers. Teachers learned to use various applications to produce strong learning outcomes in digital contexts. Administrators learned to keep everything going. The demands of the pandemic shined a bright light on an already growing trend – self-directed learning.

Self-directed learning [SDL] occurs when learners plan, perform, and assess learning. This may be recognized as DIY projects or self-help guides and workshops. In any case, learners seek knowledge and skills of their own volition. It may be best to think of SDL as an umbrella term encompassing both the internal needs that prompt one to become a self-directed *learner* (i.e., motivations of the learner) and the processes of self-directed *learning* (i.e., actions by the learner) (Hiemstra, 1994). Think of this internal characteristic as intrinsic motivation – "the inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and **to learn**" (Ryan & Deci, 2000b, p. 70; emphasis added). Despite students perhaps lacking motivation in the classroom, all are willing to learn something (Christophel, 1990); moreover, as reported by the 2019 Pearson Global Learner Survey, many students nowadays are

willing to do this throughout their lifetime and in spaces beyond the classroom (i.e., lifelong learning).

SDL opportunities have been expanded through the use of digital information and communication technologies [ICTs]. The unique flexibility proffered by these digital tools allows users to learn what, how, when, and where they choose using ICTs and other learning tools with which they are already comfortable (Cabrero & Román, 2018; Jadlemark, 2018; Pearson, 2018). The reality is simple: ICTs and other learning tools help facilitate SDL. Scholars argue for self-direction to be felt, learners must be in control; learners must self-regulate; and learners must engage in interactions with the physical and/or social worlds (Saks & Leijen, 2014; Stubbé & Theunissen, 2008). These active strategies alone, however, are not enough (Hiemstra, 1994; Sava et al., 2020); self-directed learners need also be intrinsically motivated. The question, then, is why the study of SDL takes place predominately in contexts where intrinsic motivation is no guarantee.

Statement of Problem

In formal education spaces like a classroom, the intrinsic motivation needed for SDL is possible but not guaranteed. No teacher can directly motivate a student (Christophel, 1990; Pink, 2009; Richmond, 1990). Motivation remains with the student; yet, by creating conditions to satisfy learners' basic needs (i.e., autonomy, relatedness, competence), instructors contribute to potentially increased intrinsic motivation (Deci & Ryan, 1980, 2000; Deci et al., 1991; Deci et al., 1996; Ryan & Deci, 2000a, 2017). Herein lies the problem: by design, motivation in formal education stems from rewards/punishments (Deci, 1971) – which do not always work – and regulation often remains with the instructor (Coombs, 1989; Coombs & Ahmed, 1974). Instructors initiate learning experiences, provide support and scaffolding throughout, and offer

assessment and feedback. While learners' actions in the formal education environment may be self-directed, learners may not be intrinsically motivated (Legault & Inzlicht, 2013; Reeve, 2009). Thus, when it comes to studying SDL, it may be necessary to study a different learning context.

Studies of self-directed learning and learner self-direction may be well-suited for more informal learning environments. If formal contexts, such as the classroom, account for 20% of our learning, informal contexts make up much of everything else and account for 80% of a person's learning experiences (Coombs & Ahmed, 1974; Gibbons & Phillips, 1982; Latchem, 2016; Schugurensky, 2000). In informal contexts, learners "…learn what [they] can also decide not to learn" (Gibbons & Phillips, 1982, p. 69), engage in conscious or self-determined learning (Deci & Ryan, 1980) that is intrinsically motivated, and retain control of the learning experience (Mocker & Spear, 1982). Because informal learners lack a formal instructor, they determine their own goals and plans, curate resources and tools, modify strategies to increase personal competence, and decide to continue or end learning – *all independently*. While scholars have illustrated the advantages of and devised strategies to increase self-direction in the classroom (Nilson, 2013; see also Mentz et al., 2019), learners in informal spaces self-direct more naturally and may demonstrate unique learning strategies. This does not suggest SDL in informal spaces is *always* successful; to the contrary, self-direction in informal environments means learners are not only starting intrinsically motivated but maintaining that throughout the learning episode. The bigger question is "*how?".*

While instructors in formal education contexts may create conditions to satisfy students' needs, this depiction may not wholly represent the informal context. But, what *is* known is that adult learners in informal contexts are more likely intrinsically motivated (Knowles, 1975;

Knowles et al., 2005), so understanding what drives informal learners may shed light on adult learners' motivation more broadly, including adult learners in formal spaces. For instance, a self-directed learner may informally learn about architecture because of personal interest. However, while learning, the learner may lose interest and quit. The question, in this instance, is not *if* intrinsic motivation existed, but the degree to which each of this learner's basic needs was satisfied or not (Cerasoli et al., 2016). Ultimately, studying SDL in informal contexts – when learners are intrinsically motivated, self-regulate, and utilize learning tools that match their needs – may provide a type of roadmap for increasing similar behaviors in formal spaces.

Preview of this Dissertation

The goal of this dissertation is to explain how self-directed learners engage in self-directed learning in informal contexts. In this dissertation, I employ multiple phases consisting of both qualitative and quantitative methods to examine how learning context matters in studies of SDL (Candy, 1991; Furlong & Davies, 2012; Jadlemark, 2018; Lai et al., 2013; Levenberg & Caspi, 2010; Mills et al., 2014; Rogoff et al., 2016). I combine semi-structured interviews and a large open-ended survey to better understand the conditions which lead to a self-directed learner's continued learning. Qualitative methods allow for exploration of both self-directed learners (i.e., motivations) and self-directed learning (i.e., actions) as well as perceived actions made possible by the learning context (i.e., perceived affordances of learning tools). I argue throughout this dissertation that understanding adult learners' experiences in informal contexts – where they are intrinsically motivated, in control, and permitted to use tools of their choosing – may reveal ways to introduce informal learning to formal contexts.

In what follows, I review the current literature to provide both context and foundation regarding informal and self-directed learning. I begin with a breakdown of learning contexts and

specifically highlight the continuum that exists between formal, nonformal, informal, and self-directed learning. Next, I dissect what it means to be a self-directed *learner* (i.e., intrinsic motivation) – operationalized as the satisfaction of three innate needs (i.e., autonomy, competence, relatedness) (Deci & Ryan, 2000) – with increased focus how learners satisfy these needs when self-teaching. I follow this with a breakdown of self-directed *learning* (i.e., self-regulation), including the various strategies and resources learners may employ in informal contexts. This will be coupled with an exploration of users' perceived affordances from the ICTs and other learning tools. The increased flexibility of current learning technologies grants learners the freedom to choose the types of resources they most prefer to meet their learning needs. The salience of each basic need may influence how learners use the technology (Boileau, 2018; Cox, 2012; Norman, 1999).

Research Questions

This dissertation is steered by the following research questions:

RQ_1: How do self-directed learners in informal contexts satisfy their need for a) autonomy, b) relatedness, c) competence, and d) prioritize the satisfaction of these needs?

RQ_2: How do self-directed learners in informal contexts self-regulate their learning?

RQ_3: What affordances are perceived by informal learners during self-directed learning?

RQ_4: What relationships exist among the satisfaction of learners' basic needs, self-regulation, and perceived affordances during self-directed, informal learning?

CHAPTER 2: REVIEW OF LITERATURE

People spend much of their time seeking information, and in many cases, because they "have the internet," they "can get instant answers" (Daniella). This is unsurprising: Cross (2007) defined Google as one of the world's most popular teachers, Selwyn et al. (2006) described ICTs as "inherently educational" (p. 142), and many learners already turn to YouTube or Google for answers (Pearson, 2018). In doing so, however, learners lose the features they come to identify as parallel to learning: a teacher, a curriculum, some credentials, and a sequence.

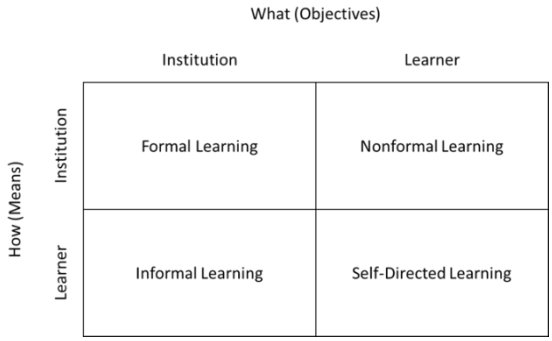
This review of literature explores both aspects of SDL as identified by Hiemstra (1994; see also van der Walt, 2019): intrinsic motivation experienced by a self-directed *learner* and the actions/self-regulation of self-directed *learning*. To start, I explicate the distinctions between formal and informal learning to illustrate how learning occurs on a continuum (i.e., learning can be formal and informal). Following, I break down the three innate needs – autonomy, relatedness, and competence – that are said to allow for intrinsic motivation and discuss what may occur with these needs in informal contexts. Conditions of the formal education context *may* potentially promote learner intrinsic motivation; however, in informal contexts, different factors may influence learners' satisfaction of autonomy, competence, or relatedness. Then, I explore self-directed learning by focusing on self-regulation. Learners in informal contexts retain control. Finally, I discuss the role of perceived affordances in informal learning. The increased flexibility wrought by technologies allows learners to engage in self-teaching anytime and anywhere, but how they do this may have some connection to the salience of their basic learner needs and each learners' perceived affordances.

Learning Contexts

In what follows, I explore the differences between formal education and informal learning to demonstrate why research on SDL in formal contexts may not always wholly depict SDL in informal contexts. Important distinctions have kept separate formal, nonformal[1], informal, and self-directed learning (Mocker & Spear, 1982) (see Figure 1). These distinctions are drawn based on who controls *what* and *how*. However, through this dissertation, I argue learning contexts are not as rigid as this typology presumes. Rather, the space between formal and informal learning is represented best as a continuum (Boileau, 2018; Manuti et al., 2015) rather than a dichotomy. Importantly, students in formal contexts can be self-directed and feel intrinsic motivation (Saks & Leijen, 2014), so SDL is not restricted to just formal or just informal contexts. However, research exploring self-direction is often situated within formal spaces, which may not capture the complexities that exist when learners engage independently, but the distinctions between formal and informal contexts indicate studies of one context do not illuminate the other.

Figure 1

Lifelong Learning Model. (Mocker & Spear, 1982)



[1] This dissertation acknowledges nonformal education; however, this context exists outside the scope of this project, and thus, it was not included in this project.

In formal education, the institution (indirectly) and a trained expert dictate what is learned and, often, how it is learned. Formal contexts rely on a sequence of learning that is incremental, guided by a trained expert, and operates under a system of laws and norms (Dewey, 1916; Sharma & Choudhary, 2015). These systems use rewards (e.g., grades) and punishments (e.g., also grades) to encourage students; students' work is compared against a standard of what knowledge should and would look like, with mastery determined for the student by the instructor (Eshach, 2007; Schugurensky, 2000). Because of this routinized structure, formal education functions much the same regardless of the number of students (Sharma & Choudhary, 2015) or if the learning occurs face-to-face or is technologically mediated (e.g., MOOCs, e-learning). Contrarily, moving learning to an online environment, despite students' abilities to engage in locations and at times of their choosing, does not make learning informal. If instructors place restrictions or requirements, they are taking some control from the students (e.g., Gikas & Grant, 2013); the more control lost, the more learning is formal (Clough et al., 2008; Gorard et al., 1999; Jadlemark, 2018; Mocker & Spear, 1982).

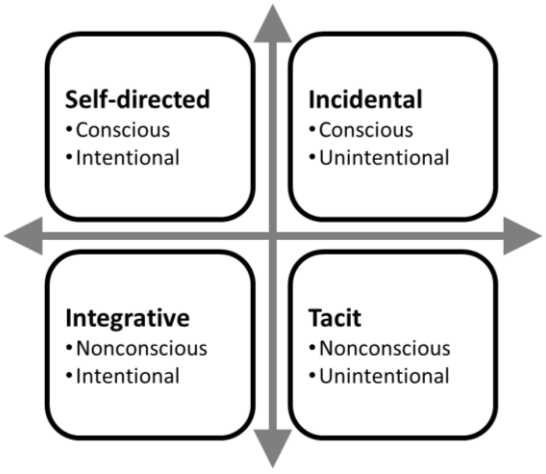
The level of control experienced by informal learners may vary by intentionality and consciousness. Informal learning is a vague term because opportunities for informal learning are vast. Coombs and Ahmed (1974) define informal learning as

> the *lifelong* process by which every person acquires and accumulates knowledge, skills, attitudes and insights from daily experiences and exposure to the environment-at home, at work, at play; from the example and attitudes of family and friends; from travel, reading newspapers and books; or by listening to the radio or viewing films or television. (p. 8; emphasis added)

It is not surprising, then, that informal learning accounts for 80% of our learning experiences (Coombs & Ahmed, 1974; Gibbons & Phillips, 1982; Latchem, 2016; Schugurensky, 2000). More so, learners are not always conscious of this type of learning, nor do they always recognize it as learning (Bandura, 1999; Bennett, 2012; Furlong & Davies, 2012; Gee, 2004; Marsick & Watkins, 2001; Marsick et al., 2006; Schugurensky, 2000). However, when learners are consciously aware of the learning and have made an intentional effort to learn (i.e., self-teaching), they have engaged in SDL (see Figure 2), which is the focus of this dissertation. It must be stated, however, that learning in informal contexts, because it is without formal guidance, is only perceived; an informal learner need only *perceive* success – it does not have to be verified to be real.

Figure 2

Four-part Informal Learning Model. (Bennett, 2012)



An important caveat must be noted: formal and informal learning are less dichotomous and more continual, in that learning can be more or less formal (Boileau, 2018; Manuti et al., 2015). The distinction, as stated, exists in *what* and *how* – so learners in formal contexts who make these decisions may engage in informal learning. However, less is known about how learners self-direct or maintain motivation in informal contexts when compared to research from

formal contexts. This imbalance derives from multiple challenges: first, definitional nuances have invited multiple interpretations of informal learning (Carliner, 2013; Rogoff et al., 2016) and self-directed learning (van der Walt, 2019). Scholars have argued SDL is a situational construct that must be studied within unique environments (Candy, 1991; van der Walt, 2019), and the increased flexibility and personalization offered from ICTs only increases the situations where this type of informal learning may occur (Boileau, 2018; Cross, 2007; Manuti et al., 2015). Incidentally, work designed to study informal learning is often formalized (perhaps, inadvertently) during the research process (Gikas & Grant, 2013; Tan, 2013), and, therefore, does not adequately reflect the informal learning context.

Second, technology has "redefine[d] the boundaries of the knowledge monopoly" (Jadlemark, 2018, p. 4), blurring the once rigid separation between formal and informal based solely on location (i.e., a continuum of learning). More importantly, users embrace learning through these technologies (Pink, 2009) but not in unified ways. The control granted to informal self-directed learners brings with many distinct ways to learn (Furlong & Davies, 2012) and a lack of standardization (Eppard, 2017). Learners engage in unique and personal strategies; this variation complicates research attempts.

Third, the context of learning, whether formal or informal, influences how learners engage in learning (Candy, 1991; Furlong & Davies, 2012; Jadlemark, 2018; Lai et al., 2013; Levenberg & Caspi, 2010; Mills et al., 2014; Rogoff et al., 2016). While SDL can and does occur in formal education contexts (Saks & Leijen, 2014), the presence of a set curriculum passed down by a selected expert who assesses mastery often results in learners who may not be intrinsically motivated or hold enough control to be fully self-directed (Ebner et al., 2010). On the other hand, some important informal learning experiences are near invisible or just-in-time

(e.g., *Googling* something) (see Cross, 2007), resulting in learners who do not know they have learned (Gorard et al., 1999; Livingstone, 1999; Peeters et al., 2014), while others are planned, with specific consideration paid to learning resources, strategies, and outcomes. During these planned moments, learners engage with intentionality to teach themselves; to learn is the goal.

Self-Directed Learner vs. Self-Directed Learning

Self-directed learning (SDL), in simple terms, is personal responsibility for learning, and self-directed learners engage both consciously and intentionally in learning (Bennett, 2012; Garrison, 1997; Husmann et al., 2018; Mocker & Spear, 1982; Niemiec & Ryan, 2009). Based on this definition, SDL may occur in multiple learning contexts and is characterized by learner control of what is learned and how it is learned. Knowles (1975), considered the father of Self-Directed Learning, defined SDL as

> a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. (p. 18)

By this definition, SDL is a conscious effort exhibited through a learner's actions. In general, SDL "…draws heavily on the learner's experiences, is problem centered, is motivated by the learner's internal incentives, and is judged to be successful or not by the learner" (van Noy et al., 2016, p. 42-43). Learners actively self-regulate learning because informal contexts lack other interactants to do so.

Second, a self-directed learner is intentional (Bennett, 2012; Knowles, 1975); learning is the goal. This often stems from a learner's agency, or the capacity to act (Ahearn, 2001; Deci & Moller, 2005; Downes, 2010; Montenegro, 2017; Reeve & Tseng, 2011). In informal contexts,

no one sets the learner's task for them; no one prompts these learners to continue; no one offers techniques or tips for better knowledge/performance – at least not without the learner's prodding. Thus, when examining the continuum between formal and informal learning, SDL occurs when learners are self-determined, or intrinsically motivated (Ryan & Deci, 2000b). Formal contexts, with their set curriculums, routines, etc., may not provide enough agency for learners to act intentionally (Ebner et al., 2010).

The increased agency, however, does not automatically mean the learner will perceive him/herself as having *learned*. I define learning as a learner's "ability to do something they could not do before" (Boileau, 2011, p. 13). For instance, a novice guitar player who initiates learning and consciously uses informal resources may not find the expected levels of success and quickly disengage. Some mitigating factors were either absent, or present, which may have left the learner less motivated, but these factors remain unclear. I argue learners' basic needs may explain this behavior.

Basic Learner Needs

While no instructor can directly motivate students (see Christophel, 1990), they can create conditions that help satisfy a learner's basic needs, a precursor to increased intrinsic motivation (Deci & Ryan, 2000). Maslow (1943, 1954) argued basic (physiological, psychological, etc.) needs must be met before an individual will feel motivated to progress onward in a task or endeavor. It is in the satisfaction of these needs that learning contexts diverge. In formal contexts, a hired expert helps create conditions to optimize learning, and in doing so, allows a learner to adopt more responsibility for learning (Deci & Ryan, 2000); in informal contexts, learners adopt this responsibility themselves as they are inclined to satisfy

these same needs (Deci & Ryan, 1980), which means, it is not a question of if these needs are satisfied in informal contexts, but how salient those needs are perceived (Cerasoli et al., 2016).

Before discussing how these needs are satisfied in both formal and informal contexts, it is necessary to understand the autonomy-control continuum (Sheldon et al., 2017; Weinstein et al., 2012). Theorists Deci and Ryan (1987) argued for a Self-Determination Theory (SDT), which posits motivation varies and is influenced by a learner's level of control (i.e., regulation) (Ryan & Deci, 2017). Autonomous regulation occurs when learners have volitional control and wholly engage in the learning activities; conversely, controlled regulation occurs when learners perceive some external/internal pressure or are "compelled to act" (Ryan & Deci, 2017, p. 14). When the autonomy-regulation continuum is imposed on the learning contexts continuum, more autonomous regulation coincides with more informal opportunities to learn.

The point on the autonomy-control continuum a learner falls is influenced by, among other factors, the learning context (Candy, 1991; Furlong & Davies, 2012; Jadlemark, 2018; Lai et al., 2013; Levenberg & Caspi, 2010; Mills et al., 2014; Rogoff et al., 2016). In formal education, the emphasis is on rewards and punishments, examples of extrinsic motivators (Ryan & Deci, 2000b) or what Pink (2009) refers to as *carrots and sticks*. When learners are motivated primarily by external motivators, they adopt more controlled, regulatory styles (i.e., compliance) and often "learn less well" (Deci & Ryan, 1987, p. 1032). As instructors create conditions that satisfy learners' needs, they are also helping learners internalize control of the learning process and outcomes, moving from controlled to autonomous behavior (Deci & Ryan, 1987; Gagne & Deci, 2005; Richmond, 1990). In short, increased intrinsic motivation stems from the satisfaction of learners' needs (Baker & Goodboy, 2018; Frymier et al., 2019; Goldman & Brann, 2016), and as learners are more motivated, they will willingly accept control of learning (Chen et al., 2015;

Deci et al., 1991; Frymier, 2016; Niemiec & Ryan, 2009; Ryan & Deci, 2002; Zimmerman & Schunk, 2008). Making learning more informal, even in formal contexts, takes advantage of adult learners' already existing motivation.

Though research offers explanations or strategies to satisfy students' basic learner needs in formal contexts (Goldman & Brann, 2016), we cannot assume these are the same conditions when applied to informal contexts. In informal contexts, learners engage out of interest and curiosity (Callanan et al., 2011; Isen & Reeve, 2005; Rogoff et al., 2016; Song & Bonk, 2016). This intrinsic motivation is presumed, but success is not guaranteed. In many cases, the elements most associated with formal education (e.g., feedback, relationships) may be minimal or absent. In what follows, I examine the role of each basic need in allowing for increased motivation (see Wang et al., 2019) and offer potential challenges to each need as gleaned from the literature on informal learning contexts which may complicate or facilitate that need's satisfaction.

Need for Autonomy

The need for autonomy explains an individual's desires to be the author, investor, and director of their experiences. In the classroom, this is exemplified when learners have choices and hold an active role in the learning process (i.e., learners are autonomous when learners are in control) (Chen & Jang, 2010; Deci & Ryan, 1980, 2000; Niemiec & Ryan, 2009; Weinstein et al., 2012). However, and as noted, learners whose motivators are extrinsic are more likely to engage out of compliance, as is often the case in formal contexts. This has led some past scholars to argue that learners' need for autonomy must be satisfied for that learner to be self-determined, or intrinsically motivated (see Deci et al., 1991; Goldman & Brann, 2016). Specific actionable steps from instructors may help students feel autonomous.

Understanding student autonomy starts with understanding the role of the instructor in a classroom. Since formal education operates under systems of laws and norms, instructors often retain control over the learning process (Reeve & Jang, 2006). To grant some control to students, instructors may engage in autonomy-supportive behaviors, such as promoting diverse topic choices, adapting course materials for specific student needs, encouraging open discussion, displaying passion about course activities, providing task rationale, and acknowledging negative feelings (Chen & Jang, 2010; Deci & Ryan, 1987; Goldman & Brann, 2016; Patall et al., 2013; Reeve, 1998, 2009; Reeve & Shin, 2020; Shen et al., 2009; Song & Bonk, 2016). The instructor maintains control over learning while granting students opportunities to self-direct.

Instructors hope for student engagement and investment in formal learning contexts, and by increasing the relevance of the course material, instructors can accomplish both. Formal education, because the content is predetermined, may not provide students opportunities for genuine interest in the content, so instructors "need to find ways to show the relevance of topics" if they want to increase learner motivation (Kember et al., 2008, p. 255). Providing students with choices and allowing learners to control *what* they learn and *how* they learn it may increase those learners' relevance toward the topic (Prinski et al., 2018); additionally, instructors may have students set mastery goals and help them track personal progress toward these goals (Cerasoli et al., 2016). In both instances, learners may experience increased interest (Martens et al., 2010), which may further increase intrinsic motivation (or combat more extrinsically motivating factors) (Handelsman et al., 2005; Isen & Reeve, 2005).

Of course, instructors do not hope for only cognitive gains; affective learning, the perceived importance or value of the material or learning process, is also tied to learner interest or relevance (Hess, 2015; Mazer, 2012). Increased affective learning aids learners in applying the

material beyond the classroom, is manifested through both positive (e.g., pride) and negative (e.g., shame) emotions, and has been linked to increased autonomy (Deci et al., 1991; Fredericks et al., 2003; Hess, 2015; Trowler, 2010). Learners who feel increased interest and find the learning valuable are more likely to engage in the learning process (Kucuk & Richardson, 2019), and, thus, instructors in formal education contexts satisfy students' need for autonomy by allowing for opportunities to increase enjoyment. Further, by helping learners find value in the task and the learning process, instructors can satisfy learners' need for autonomy (Cerasoli et al., 2016; Deci & Ryan, 2000; Gagne & Deci, 2005; Niemiec & Ryan, 2009).

Informal Learning and Autonomy

A learner's level of autonomy is their control, and informal learning is classified as allowing learners control, so learners' need for autonomy should be satisfied in informal environments. Further, regarding informal learning, scholars argue learners value control over processes and goals (Clough et al., 2008; Dabbagh & Kitsantas, 2012; Lai et al., 2013) partially because, in informal learning contexts, learners retain *agency* – the capacity to act or initiate learning (Ahearn, 2001) – exhibited through expressions of self, control, and independence (Downes, 2012). Because learners in informal contexts initiative, distinct challenges – such as not knowing when to continue, when to stop, or when to change tactics – may thwart a learner's need for autonomy.

In formal contexts, instructors retain control, and of all things they retain control of, the schedule and design of a course are paramount. One key autonomy-supportive behavior for learners is structure (Darby & Lang, 2019; Garrison & Cleveland-Innes, 2005). Because instructors prepare detailed plans, they keep learners driven in the "correct" direction. In informal contexts, an instructor does not exist to create a learning structure, so learners must rely

on autonomous regulatory strategies to ensure cognitive gains (Shea & Bidjerano, 2012). This is particularly poignant in digital learning environments.

The gamut of information available and students' general lack of pedagogical knowledge to sort and structure highlight three potential obstacles that are only exacerbated by learners' perceived success. First, learners are not accustomed to controlling their learning. Despite the potential to allow students control, instructors seldom do so (Reeve, 2009); and, when opportunities are provided, students do not know how to seize them (Tan, 2013). This may leave them without strategies to implement in informal contexts; simply, they do not know how to teach themselves effectively. Second, "people can often learn wrong information" (Eppard, 2017, p. 34), such as self-diagnosing using WebMD, and not recognize this error. Further, because informal learners need only perceive success, they may stop accessing information prematurely. Third, learners may not possess the competence to know what they don't know (Deci & Moller, 2005), and without this competence, learners cannot proceed. Without the guidance of a trained expert, the level of control may have adverse consequences. While we can presume self-directed learners in informal contexts feel control, we cannot say that this satisfies their need for autonomy, and therefore, I pose the following research question:

RQ_{1a}: How do self-directed learners in informal contexts satisfy their need for autonomy?

Need for Relatedness

Learners' need for relatedness is satisfied as they develop and keep relationships during learning. Learners want to connect to and feel seen by peers and the instructor (Cerasoli et al., 2016; Deci & Ryan, 2000; Dwyer et al., 2004; Ryan & Deci, 2017), with the student-instructor relationship receiving increased attention in formal contexts (Frymier & Houser, 2000). Educational theorist Lev Vygotsky argued a difference exists between what learners can do

alone, what learners can do with aid, and what learners cannot do. He labeled this the Zone of Proximal Development [ZPD], which highlights the necessary role of the other in the learning process (Vygotsky, 1934, 1978). Whether this other is an instructor or a peer, feeling connected to or closer with others during learning fosters positive student well-being (Dolan et al., 2017; Garrison & Arbaugh, 2007; Garrison et al., 2000; Hew, 2016; Hill & Jones, 2018; Kaufmann et al., 2016; Lerdpornkulrat et al., 2016; Ryan & Powelson, 1991; Shea & Bidjerano, 2009) and helps satisfy the need for relatedness.

Relationships are not restricted to formal, brick-and-mortar contexts, yet computer-mediated communication (CMC) scholars do lament online relationships require different steps to cultivate when using technology (Walther, 1992; Walther et al., 2015). Walther's *social information processing* (SIP) indicates humans seek relationships, regardless of modality, but that these relationships may take more time to develop. These relationships change and grow over time (Horan et al., 2011), especially as learners and the instructor build mutually shared meaning through *reciprocal* and *contingent* communication (Walther, 2019). However, digital contexts are often devoid of typical instructor behaviors that may indicate closeness to a student (e.g., smiling, proximity). This does not mean digital contexts lack all cues (Kelly, 2012; Kelly & Westerman, 2016); rather, users decode whatever cues are available (e.g., fonts, paralinguistic digital affordances, small talk or informal talk, self-disclosure, timely feedback, punctuation, etc. [Beins, 2016; Dixson et al., 2017; Hayes et al., 2016; Horan et al., 2011; Mazer et al., 2009; Richmond et al., 2018; Sellnow & Kaufmann, 2018]). Instructors who intentionally integrate these cues may decrease psychological distance (Vareberg & Westerman, 2020; Vareberg et al., 2020), or increase perceived closeness (i.e., immediacy) (Mehrabian, 1966), which has been

further connected with satisfying needs for relatedness in formal contexts (Frymier et al., 2019). These principles should apply regardless of instructional context.

Informal Learning and Relatedness

While original models of informal learning focused on the learner as *agent* (Marsick & Watkins, 2001; Watkins & Marsick, 1992), recent iterations highlight the role of others (Watkins et al., 2018). Informal learning scholars identify the nonlinear and socially nested nature of this type of learning. However, the use of ICTs and other learning tools allows for personalization, perhaps at the expense of relationships. If a learner can do what they want, the need for others may diminish.

Self-directed learners in informal environments likely feel heightened senses of personalization. In formal contexts, personalized learning is achieved when flexible assignments, interactive environments, and strong relationships create a unique learning experience (Waldeck, 2007; see also Dabbagh & Kitsantas, 2012, 2018). The use of immediacy cues strengthens this perception. Conversely, in informal contexts, learning is inherently personalized (Song & Lee, 2014) because learning is often relevant to personal interests (also, identity; see Prinski et al. [2018]): as learners explore a topic, their investment of time allows them to feel a personal connection. This may subsequently encourage learners to invest more time without the aid of an instructor or concern for potential relationships.

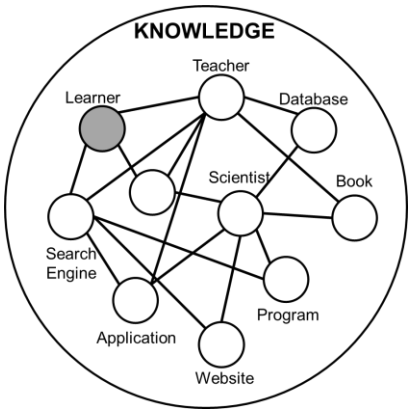
The increased personalization may occur at the expense of or thanks to relationships formed, though these relationships may vary in terms of reciprocity and contingency. Informal learners may seek out specific groups of like-minded individuals (Ebner et al., 2010), which suggests increased levels of reciprocity and contingency thanks to a shared frame of reference (Walther, 2019). Learners may identify and interpret relevant digital paralinguistic cues; for

instance, likes, comments, and shares may indicate to a learner that a reference is either valued or not (Shoufan, 2019). The use of a discussion thread or forum may contribute to a feeling of community. But the reverse may also be true. Self-directed informal learners may use multiple sources in combination, with individual resources becoming irrelevant (Jadlemark, 2018); learners may seek specific and pinpointed information (Cabrero & Román, 2018; Utecht & Keller, 2019); or learners may consult various weak ties (see Granovetter, 1973) – all sources with whom they may not *want* a relationship. While the learner holds a potentially social role, this does not mean the learner wants reciprocal or contingent communication (Siemens, 2005, 2006).

Technology has increased the number of potential others who could be involved in informal learning, with each other serving as only another *node* in a learner's network. A node is defined as a trusted source (AlDahdouh et al., 2015; Kop & Hill, 2008; Siemens, 2006; Siemens & Tittenberger, 2009); further, node selection may be a socially driven decision as the technologies used often hold social purposes (Yot-Domínguez & Marcelo, 2017). Learners select nodes based on their authority, recommendations from others, or perceived usefulness while ignoring other nodes (AlDahdouh, 2018). ICTs provide learners access to a more diverse array of nodes than may have otherwise been available. This diversity is a cornerstone of Siemens' (2006) theory of connectivism. As learners engage in informal SDL, they may seek various sources to encourage diverse thinking or perspective-taking (see Figure 3). As a result, learners may continue to refine knowledge or gain a more nuanced perspective than they would from a single-node (i.e., teacher) network.

Figure 3

'Learner' as a Node in a Network. (adapted from AlDahdouh et al., 2015)



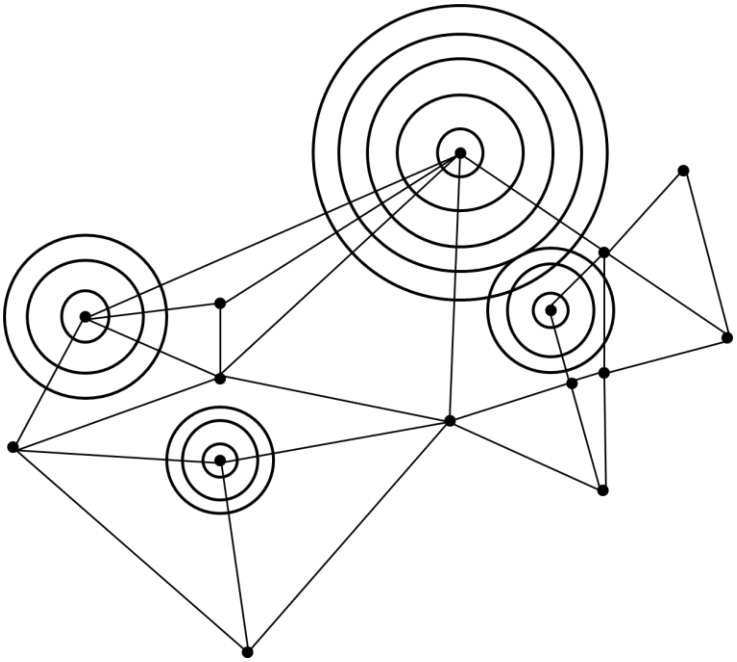
These nodes, combined, form a larger learning network. Knowledge now is curated from several relevant nodes as opposed to a small number of experts (Downes, 2008, 2010, 2012; Siemens, 2005, 2006). Siemens argued "knowing and learning are today defined by *connections*" and that connectivism views learning as "primarily a network-forming process" (2006, p. 15, emphasis added; see Figure 4). Simply, while not all individuals seek learning, all seek connections. A learning network is most often associated with ICTs. ICTs connect users with other people or with machines, and if learners choose, they can add a resource to their learning network (AlDahdouh, 2018; Boileau, 2018; Czerkawski, 2016; Dabbagh & Kitsantas, 2018; Jadlemark, 2018; Osborne & Dillon, 2007), culminating with a hand-selected library of resources. ICTs extend the number of potential contacts by increasing access to weak ties (Granovetter, 1973). This means a learner who talks to an instructor, reads a textbook, watches a YouTube video, engages with a buddy on social media, reads an expert's blog, and searches Wikipedia is accessing equal nodes from their learning network. The more learners use their devices, the more they may be able to make connections and engage in learning (Rashid & Asghar, 2016). But, despite these learning networks and the abundance of nodes, learners who need the help of others to close the ZPD may still lack a clear option. It may be, then, that the

more personalized the learning, the more unnecessary relationships are, or vice versa (the more unnecessary the relationship, the more personalized the learning); this uncertainty has prompted me to pose the following research question:

RQ_{1b}: How do self-directed learners in informal contexts satisfy their need for relatedness?

Figure 4

Learning as Network Forming. (Siemens, 2006)



Need for Competence

To satisfy their need for competence, students need to feel mastery or the ability to meet a challenge. In formal contexts, this may be assessed by answering the following: *what does a person know and is able to do*? Cerasoli et al. (2016) defined competence as the combination of optimal challenge and feedback. In formal contexts, instructors may engage in behaviors that satisfy learners' need for competence, including rationalizing the task, allowing for a showcase of student work or public praise, engaging in active learning, integrating problem-based or inquiry-based learning, providing optimal challenge or intellectual stimulation, incorporating

effective course resources, presenting material in multiple ways, conveying confirmation, and/or, providing multiple opportunities for and instances of written and oral feedback that is clear and targeted to the learner (Bolkan, 2015; Cerasoli & Ford, 2014; Chen & Jang, 2010; Goldman & Brann, 2016; Hew, 2016; Isen & Reeve, 2005; Martens et al., 2010; Pintrich & de Groot, 1990; Ryan & Powelson, 1991). The latter two behaviors – confirmation and clear feedback – are central to satisfying students' need for competence in formal contexts but are potentially absent in informal contexts.

Feedback intervention is inherently an attack on a student's competence, but instructors who offer confirmation during feedback mitigate this threat. Instructor confirmation behaviors are brief moments of encouragement or endorsement; signal to students they are valued, respected, and acknowledged; and have been labeled "crucial" (Ellis, 2000, p. 287) to the formal education context (Ellis, 2004; Myers et al., 2014). This is because learners will seek guidance to achieve optimal performance (Vygotsky, 1934, 1978), but this feedback, inherently, attacks their competence (Deci & Moller, 2005). Potentially negative feedback may dissuade the learner or shatter any internalized motivation. Equally, it is difficult to develop competence without feedback (Darby & Lang, 2019), so the use of feedback in formal education is necessary. Instructors' confirmation behaviors help balance the potentially negative encounter by increasing student affect (Finn & Schrodt, 2016; Goldman & Goodboy, 2014; Goldman, Goodboy, et al., 2017; Isen & Reeve, 2005; Kerssen-Griep & Witt, 2012; ten Cate, 2012), which may ultimately lead to increased learner internalization (Deci & Ryan, 2000).

Students also benefit from clarity behaviors during feedback. Clear, pinpointed feedback which effectively conveys the material(s) (Chesebro & McCroskey, 1998) has been linked to increased cognitive learning, affective learning, engagement, and credibility (Comadena et al.,

2007; Johnson, 2017; Mazer, 2013; Myers et al., 2018; Schrodt et al., 2009). Further, while clarity behaviors are sought by students in formal contexts (Bolkan, 2017; Goldman, Cranmer, et al., 2017) as they result in less ambiguity, their interpretation may differ between students and instructors (Sieburg, 1973; Titsworth & Mazer, 2016). Instructors may engage in what they perceive to be clarity behaviors but cannot guarantee students will perceive the message as clear. Regardless, feedback is an opportunity to satisfy students' need for competence, and by using confirming and clear feedback, instructors can help do that.

Informal Learning and Competence

The personalized use of feedback is unique to formal education contexts. The presence of a trained expert and the interpersonal dynamic that often develops between expert and learner (see Frymier & Houser, 2000) allows these moments of feedback to satisfy students' need for competence (Deci & Ryan, 2000; Frymier et al., 2019; Goldman & Brann, 2016) despite the negative nature of feedback. But the role of feedback is markedly different in informal learning contexts, especially when the learner is self-directed. In the classroom, the question of "how do I know what I know" is generally answered by an expert, through optimal challenges and clear, confirming feedback. In informal contexts, the learner must answer this question through self-assessment.

Unlike formal contexts, when a trained expert can determine learner success/failure, in informal contexts, especially those where the primary learning resource is ICTs, the learner independently assesses progress. Informal learning has been described as "an inductive process of action and reflection" (Marsick et al., 2006, p. 7; see also Watkins & Marsick, 1992), or trial and error. In this learning context, learners determine what to learn, how to learn it, and then decide if, and how well, learning occurred. However, because of the fun, interest, or excitement

wrought from most informal learning experiences (Song & Bonk, 2016), learners may willingly engage in learning longer or more often than they would for formal learning. Each trial-and-error cycle is capped with the learners' self-assessments – comparison between current to past self (Boud, 1995) – during which learners determine if the skill or knowledge has been learned or that they "can do something they could not do before" (Boileau, 2011, p. 13). Success comes when the learner deems the answer to this question is *yes*; failure is when the learner deems themselves unable to learn it or stops the learning process.

Unique challenges complicate learners' satisfaction of competence in informal self-directed learning. SDL is distinct in that learners initiate learning, assume control, and self-regulate the process (Knowles, 1975; Saks & Leijen, 2014; Stubbé & Theunissen, 2008), but if learners are low in competence, they may be less inclined to implement self-regulation strategies (Pintrich & de Groot, 1990). Furthermore, because the learner acquires resources, they may inaccurately assess their abilities, select the wrong materials, and subsequently not face a challenge (Cerasoli & Ford, 2014; Cerasoli et al., 2016) or face *too much* of a challenge and react negatively (Legault & Inzlicht, 2013). Without the use of confirming and clear feedback, without someone checking acquired knowledge, without someone identifying level- and ability-appropriate resources, and without the interaction learners desire, self-directed informal learners satisfy their need for competence, but how they do this is unclear. This leads me to the following research question:

RQ_{1c}: How do self-directed learners in informal contexts satisfy their need for competence?

It must also be highlighted that these needs are not equal within formal education contexts. Scholars have argued that the need for autonomy is pivotal for learners to be self-directed (Deci et al., 1991; Goldman & Brann, 2016), that one with more competence will adopt

more autonomy (Lan & Hew, 2020), that increases in autonomy/competence can increase learner interest (Martens et al., 2010), that relatedness most predicts autonomous motivation (Wang et al., 2019), and that competence was the most robust predictor in a meta-analysis (Cerasoli et al., 2016), but each of these stems from a formal education context. Less is known regarding how these needs are satisfied in unstructured learning contexts (Boekaerts & Minnaert, 1999), which prompts the following research question:

RQ_{1d}: How do self-directed learners in informal contexts prioritize the satisfaction of their basic learner needs?

Self-Regulated Informal Learning

Meeting learners' basic needs helps create conditions to increase intrinsic motivation, but SDL also addresses the physical, actionable steps taken to increase knowledge (Hiemstra, 1994). To avoid confusion between terms, when addressing these actions, this dissertation will use self-regulated learning, already identified as a required component of SDL (Stubbé & Theunissen, 2008). Self-regulated learning (SRL) involves three actionable steps: learners initiate and control their learning (McCombs & Marzano, 1990; Zimmerman, 1990; Zimmerman & Schunk, 2008); learners progress through three stages, including developing goals (i.e., forethought), curating and analyzing resources (i.e., performance), and assessing progress (i.e., assessment); and learners experience cognitive, affective, and motivational impacts (Panadero, 2017).

Learner Initiation and Control

SRL involves intentional choices made by the learner. In formal contexts, instructors may provide opportunities for choice (Deci & Ryan, 2000), but that does not reassign initiation. The result is an often hierarchical separation between the instructor and student (Hess & Mazer, 2017; Mainhard et al., 2018). This creates potential rifts in the classroom, as humans are

instinctively organismic and want to be in control of their actions (Bandura, 1994, 1999) by perceiving an internal locus of causality (Ryan & Deci, 2000; Sheldon et al., 2017). In informal contexts, learners *choose* to learn (Gibbons & Phillips, 1982), positioning initiation as an essential characteristic of SRL (Knowles, 1975; Stubbé & Theunissen, 2008). What is less clear, however, is how learners maintain this control in informal contexts.

The ability for learners to initiate and control learning has expanded in response to the increased use of ICTs and other learning tools. Learners are presented with countless resources (Ryberg et al., 2012) and determine the value of the resource independently. While increased autonomy is desired, too much freedom may result in the selection of subpar resources based on arbitrary cues (e.g., length; thumbnail) because, to the learner, the resource is good enough. Furthermore, increased agency means learners may choose to *disengage* – no one necessarily stops them from dropping out. Moments of frustration without proper scaffolding may result in learners who *fail* – though this is private to each learner. But despite these potential challenges, research on self-regulation and technologically mediated environments focuses on formal contexts (Anthonysamy et al., 2020; Dabbagh & Kitsantas, 2012, 2018; Gibbons & Phillips, 1982; Kitsantas, 2013; Saks & Leijen, 2014; Schwier & Seaton, 2013; Selwyn et al., 2006). It is presumed these self-directed learners will engage in steps to propel their learning by identifying SRL strategies that do or do not work. These strategies coalesce around three phases.

Learner Phases

Strategies for SRL are sorted into three phases: forethought, performance, and assessment. These strategies may involve goal setting, observation, sharing information, monitoring and feedback, and/or assessment (Dabbagh & Kitsantas, 2018; Nilson, 2013; Wandler & Imbriale, 2017; Yot-Domínguez & Marcelo, 2017) – strategies also used in formal

contexts. Learners in informal contexts may utilize these strategies (e.g., an informal learner may set goals) but need not engage in SDL. It is necessary to also look for strategies that may not be present in formal contexts (Anthonysamy et al., 2020; Boekaerts & Minnaert, 1999).

Additionally, the cyclical nature of informal learning invites the repetitive use of self-regulatory strategies or the adoption of new strategies. SDL is trial-and-error, which would paint a cycle for learners that would consist of acquisition, analysis, assessment, and repeat (Panadero & Alonso-Tepia, 2014). In short, learners face numerous opportunities for informal learning *daily*, resulting in knowledge that is learned, unlearned, and relearned (Utecht & Keller, 2019). Each iteration of the cycle utilizes SRL strategies; to learn one new piece of knowledge or skill may involve multiple attempts at learning and may subsequently impact various learning outcomes.

Learner Outcomes

During SRL, learners assess their cognitive and affective proficiency. SRL serves as a holistic framework as learners determine what they know (i.e., cognitive), how they feel (i.e., affect), and whether they want to continue (i.e., motivation) (Flynn et al., 2020; Shea & Bidjerano, 2012). When learners self-assess, they cast judgments on what they can do, think, and feel. Cognitive ability is perceived by learners as knowing or being able to do something they did not or could not before (Boileau, 2011). The literature on informal contexts highlights the role of affective learning (Levenberg & Caspi, 2010), and learners' satisfaction of basic needs indicates intrinsic motivation (Ryan & Deci, 2000b). Examining self-regulation in informal contexts, given the holistic framework of SRL, provides valuable insights regarding all three outcomes.

SRL refers to steps taken before, during, and after learning. These steps are initiated by the learner, end with assessment, and may look different for each cycle or learning challenge.

Further, it is necessary to point out that, even for SDL, learners may not recognize their actions as learning or may only recognize it as learning with prodding (Gorard et al., 1999). By identifying these actionable steps, we gain an understanding of these learners' intrinsic motivation by uncovering how these strategies help or hinder the satisfaction of basic learner needs. However, it is not clear which strategies informal learners employ (Boekaerts & Minnaert, 1999); therefore, I pose the following research question:

RQ2: How do self-directed learners in informal contexts self-regulate their learning?

The strategies self-directed learners employ will likely tie back to the learning tools used, and specifically, the affordances perceived from those tools (Norman, 1999; Pellerin, 2018). In this dissertation, I heed Moreno's (2006) advice – "only by examining what learning methods a particular media affords can we draw conclusions about its effectiveness" (p. 156) – and turn next to an analysis of perceived affordances.

Perceived Affordances and Self-Directed Learning

Perceived affordances label possibilities for action derived from the context. In short, an affordance is what an object is for or what an object offers a user (Kaptelinin, n.d.). The increased access to ICTs has granted learners control not only of how and what but also of where and when (Basak et al., 2018; Dabbagh & Kitsantas, 2018; Jadlemark, 2018; Lai et al., 2013; Rogoff et al., 2016). With this anywhere, anytime option, learners create their own learning boundaries (Jadlemark, 2018) by not relying on an instructor to engage in learning. As technologies continue to advance, learners continue to find new or personalized ways of learning, perhaps allowed for by these perceived affordances (Harasim, 2017). Unsurprisingly, in the study of informal learning affordances are central (Czerkawski, 2016).

When it comes to defining affordances, scholars disagree. The study of affordances originated with Gibson (1979), who argued affordances are the possibilities of an object and are environment-specific – much like the situational nature of SDL. For instance, a mobile device is a tool built for communication purposes (Orr, 2010), but, based on a specific environment (e.g., museum), can connect one user to new knowledge and insights about artists or artwork while simultaneously connecting another to resources on automobile maintenance after arriving to the same museum and discovering a flat tire (Boileau, 2018). As Norman (1999) explained, affordances are contingent on what is perceived as important, and not on what is perceived as true; this emphasizes *perceived* affordances, a distinction I adhere to in this dissertation.

Perceived affordances identify what is important to users given their situation and goals, and, importantly, must be perceived by the user as important in that moment. The distinction is simple: while both a touchscreen and non-touchscreen devices allow for *touching*, only the former results in any type of outcome (Norman, 1999). Users who touch a non-touchscreen screen ultimately perceive no affordance because the action satisfies no goal. Ultimately, it is impossible to remove an affordance from context (Day & Lloyd, 2007; Gibson, 1979; Hodges & Baron, 1992).

Multiple scholars have worked to provide definitional clarity regarding affordances. For instance, Evans et al. (2017) identified three core presumptions of an affordance: it must *not* be an outcome of a technology, must *not* be a feature of the technology, and must vary. Dings (2020) separates affordances depending on their meaningfulness and draws from Action Identification Theory (see Vallacher & Wegner, 2011) to argue affordances are tied to user identity; a meaningful affordance is identified to a high degree and "experienced in light of the agent's diachronic [concerns across time] and interconnected concerns [concerns embedded in

agent's intentions and values]" (p. 14). What a user identifies as an affordance in each context reveals what that learner finds valuable.

Users perceive affordances based on what is important to them (i.e., values). They may be perceived in vastly distinct ways because affordances are best described as *possibilities* waiting to be discovered by users (Aguilera et al., 2018); are gleaned by learners from the contexts, the devices, and the strategies (Siemens, 2006); and are appropriated as they become applicable to the context (Treem & Leonardi, 2012; Walther, 2013). These affordances are spurred by the blurring boundary between formal and informal contexts and the increased ownership placed on the learner. Ultimately, affordances may be influenced by the "what," "how," "when," and "where" of learners' self-directed learning. Therefore, I pose the following research question:

RQ_3: What affordances are perceived by informal learners during self-directed learning?

This should not be taken as a belief that learners' need satisfaction, self-regulation, and perceived affordances exist in isolation. All three occur simultaneously. This is not distinct. In formal contexts, all three would also co-exist; the difference is that informal, self-directed learners manage all responsibilities. More so, how a learner satisfies a basic need(s), and which need that is, will likely contribute to how that learner self-regulates and to which affordances are perceived in that situation. Therefore, I pose the final research question:

RQ_4: What relationships exist between the satisfaction of learners' basic needs, self-regulation, and perceived affordances during self-directed, informal learning?

Research Questions

To review, this dissertation explores how informal, self-directed *learners* engage in self-directed *learning* and utilize various ICTs and other learning tools by answering the following questions:

RQ_1: How do self-directed learners in informal contexts satisfy their need for a) autonomy, b) relatedness, c) competence, and d) prioritize the satisfaction of these needs?

RQ_2: How do self-directed learners in informal contexts self-regulate their learning?

RQ_3: What affordances are perceived by informal learners during self-directed learning?

RQ_4: What relationships exist between the satisfaction of learners' basic needs, self-regulation, and perceived affordances during self-directed, informal learning?

CHAPTER 3: METHOD

My dissertation approached the study of SDL pragmatically by incorporating both multiple phases and multiple methodologies. This allowed the methodological choices to match closely with the questions posed (Morgan, 2013a) and for data to be triangulated to increase validity (Flick, 2007). In what appears below, I argue for use of multiple methodologies to build a more complete picture of a very complex phenomenon (Onwuegbuzie & Leech, 2005). Following, I present the methodologies for the two phases of this dissertation program, including procedures, participants and recruitment strategies, and data analysis steps.

Mixed Methods Research

Mixed method research (MMR) leverages the strengths of one methodology to make up for the deficits of another (Johnson et al., 2007). Utilizing MMR allows for the use of "the right tool for the right job" (Terrell, 2016, p. 196) and increases researcher flexibility (Johnson & Turner, 2003; Onwuegbuzie & Leech, 2005). However, scholars argue the use of multiple methods, alone, does not allow for a rich synthesis of data; each method should inform the next (DeCoster & Lichtenstein, 2007). When this type of synthesis is achieved, data present a more holistic depiction of the phenomenon.

While having previously been labeled a method of triangulation, MMR transcends one benefit. Specifically, the use of multiple methods strengthens a researcher's ability to craft and forward an argument (Johnson et al., 2007). Morgan (2013a) argues, "…what matters most is not what methods you use but how you use them and why you use them that way" (p. 52). This has contributed to scholars aligning MMR with pragmatism (Morgan, 2013b). A pragmatic approach to research makes it possible to answer a variety of questions about the social world around us by selecting methods that best fit the specific research needs.

This dissertation benefited from MMR. Some phenomena related to informal learning cannot be measured using exclusively quantitative methodologies. Cox (2012) addresses this: "with the growing complexities of formal/informal learning and the vanishing boundaries to e-learning, a mixed methodological approach is more likely to obtain the range of mixed data required" (p. 13). This dissertation employed MMR in its combination of two data collection phases: 1) in-depth, semi-structured interviews (N = 19) exploring concepts related to informal learning, broadly; and 2) a large open-ended survey with participants (N = 154) examining their past self-teaching experiences. Steps taken throughout ensured the data collected were valid and represented the phenomenon in question (Johnson & Turner, 2003; Onwuegbuzie & Collins, 2007; Onwuegbuzie & Leech, 2005). These phases are described below.

Phase 1: In-Depth, Semi-Structured Interviews

I conducted the pilot phase of this dissertation in February 2020. I designed this phase to explore students' perceptions of informal learning as contrasted to formal contexts (Kvale, 2007; Maxwell, 2005). In this section, I detail the participants and procedures utilized during this phase as well as identify how this phase informed future decisions.

Participants and Procedures

Participants for this pilot study volunteered in response to an email sent via the university listserv. I conducted 19 interviews with students from a midsized Midwestern university (see Table 1). Participants self-reported gender as 11 women (57.89%) and eight men (42.11%); ethnicity as 15 white/Caucasian (78.95%), two African American (10.53%), and two multiracial (10.53%); academic levels as seven freshmen (36.84%), three sophomores (15.79%), five juniors (26.32%), one senior (5.26%), and three *other* (15.79) (e.g., graduate student); and represented all seven colleges from the university. Participants were between 18 and 40 years of age (M =

21.37, *SD* = 5.24). Participants were assigned pseudonyms (see Appendix A) to ensure confidentiality.

Table 1

Demographics of All Participants

	Phase 1) Pilot N = 19		Phase 2) Open-Ended Survey N = 154	
	N	**%**	**N**	**%**
Gender				
Gender non-binary			2	1.30
Man	8	42.10	57	37.01
Transgender man			1	0.65
Transgender woman			1	0.65
Two-spirit				
Woman	11	57.90	89	57.79
Another Gender Identity			1	0.65
Prefer not to respond			3	1.95
Ethnicity				
African American	2	10.50	1	0.65
American Indian			2	1.30
Asian/Pacific Islander			5	3.25
Latino/Hispanic			2	1.30
Middle Eastern			1	0.65
White/Caucasian	15	79.00	130	84.42
Multiracial	2	10.50	7	4.55
Prefer to self-identify			1	0.65
Prefer not to respond			5	3.25
Age				
Mean	21.37		28.97	
Median	20		23	
Mode	18		21	
Range	18-40		18-70	
Standard Deviation	5.24		12.31	
Schooling				
High school diploma			69	44.81
Associate degree			9	5.84
Bachelor's degree			37	24.03
Master's degree			22	14.29
Terminal degree			14	9.10
Other			3	1.95
Enrollment Status				
Enrolled	19	100	115	74.68
Not enrolled			39	25.32
Education Status (if enrolled)				
Freshman	7	36.84	20	17.39
Sophomore	3	15.79	19	16.52
Junior	5	26.32	17	14.78
Senior	1	5.26	27	23.48
Graduate Student	3	15.79	32	27.83

I received IRB-approval (protocol #HS20176) to conduct this pilot study. I sent a recruitment invitation (see Appendix B) through a university email listserv including both undergraduate and graduate students. Through a two-tier, semi-structured protocol (see Appendix C), I asked students to explain both their motivations and their processes when engaging in informal learning. Interviewees were met at their arrival, escorted to a small, private room, presented with the informed consent (see Appendix D), and answered five brief demographic questions (see Appendix E). Interviews were audio-recorded and auto-transcribed using REV.com; interviews totaled 10+ hours (M = 32:15) and 320+ pages of transcripts.

This pilot protocol was two-tiered. During the first tier, I asked participants about their likes, interests, hobbies, etc., as well as what they enjoyed studying in school. These lists became fodder for these interviews and allowed me to refer to specific topics, making each interview unique to the participant; additionally, by asking for multiple topic ideas, I could compare both skills- and knowledge-based topics (e.g., for Daniella, this meant comparing processes and motivations to learn *music* with the processes and motivations to learn *pharmacokinetics*). When participants were asked how they learned about the topics they provided me, there was an overwhelmingly quick mention of *Google*; this reaffirmed my assumption that learners are turning to online resources for their informal learning (see Cross, 2007). Participants answered questions regarding resources and strategies used during informal learning, and specifically, what these resources made possible and why they were preferred over others.

The second tier of the protocol prompted learners to actively learn about one of their mentioned topics. I watched participants and asked questions while they engaged in new learning. My questions contrasted what they said they would do to learn (i.e., Tier 1) with what they performed. Participants completed small cycles of self-regulated learning that we then

dissected into stages and microprocesses to best reveal what they did and why they did it. The semi-structured nature of the protocol also permitted participants learning multiple topics or comparing multiple resources in real-time.

Situated in Larger Project

Throughout the pilot phase, I made four discoveries that contributed to the larger project. First, participants' language revealed they were concerned with what technologies *afforded* rather than how *close* they felt to the resource teacher. Second, how participants defined their success aligned with and provided a clear definition of *learning.* Third, to ensure further consistency, I shifted to *self-teaching* to define the phenomenon of interest. Fourth, this early analysis aided the development and construction of the future protocol.

First, analysis of the pilot interviews prompted my shift from a perceived immediacy perspective to a perceived affordances perspective. Initially, I presumed informal learners would desire *closeness* from whom they were learning. This did not appear the case. For example, during the second tier of the protocol, I asked participants to learn and how they selected a specific learning resource (e.g., selecting one YouTube video from the index). Participants evaluated the thumbnails, number of likes/dislikes, and troll-like nature of the comments when viewing YouTube videos, yes, but only with additional prodding. Participants made decisions *before* they made it to specific source options:

> I know from other studies that I've read or research that's been talked about, usually, the first page is your best chance to find the information you're looking for, and then usually, it's in the top 10 items that come up or the things you're looking at. So right there, the Wikipedia would probably be the number one thing I would go to. (Bradley)

Before participants selected individual resources, they made decisions regarding what was achievable because of or through a specific tool. Participants mentioned specific uses of the learning technologies – not always digital – that allowed them to reach their learning goals. As such, I shifted to a perceived affordances perspective in the second phase.

Second, pilot interviews provided empirical support for a definition of learning. How to measure learning is challenging enough in formal contexts, but in informal contexts, learners determine mastery. Pilot interviewees, when asked, "How did you know you knew what you knew?" mentioned being able to do something they could not do before, as evident by Ava:

> Like when I can do that without any other resources again on my own, then I know I got it. Like when I don't have to like, in the instance of guitar, like look at the thing and like when I don't have to like stop and try and figure out one little thing really quick when I can play it start to finish. When I can do it.

This matched with Boileau's (2011) definition of learning – an "ability to do something they could not do before" (p. 13) – and became a cornerstone of how learning was conceptualized for this dissertation. The literature on informal learning posited learners may not recognize their learning, so by asking in these pilot interviewees how they determined their success, I grounded this definition in not only the literature but also in the lived experiences of informal learners. This helped my future participants and I share a common interpretation of learning (Maxwell, 2005).

Third, analyses of pilot interviews reinforced a need to use language other than self-directed or informal learning, as these were not common in participants' vocabulary. Because I wanted learners to be aware of their learning, I opted to use *self-teaching*. This was supported by pilot interviewees, such as Ross, who explained,

> I am both the learner and the teacher ‘cause I'm trying to teach myself what they're doing by watching what they do, and I feel more that they're, and when I watch videos like that, I'm watching them do it rather than teach it. They may be trying to teach it or like explaining stuff, but I feel it's more my eyes that are trying to teach myself what's going on in this situation.

Self-teaching was used for subsequent phases when referring to self-directed, informal learning.

Fourth, I used this pilot phase to develop my open-ended survey. Emergent themes prompted early questions on the open-ended survey. For instance, participants during the pilot interviews described how much they interacted with people, ranging from no interaction with anyone to interactions with several people; moreover, these interactions ranged both very important and not important at all. Additionally, pilot interviewees needed additional prompting to discuss their learning when engaged in self-teaching; I added a metacognitive awareness scale (Schraw & Dennison, 1994) to help collect some of this thinking. I also used this scale and its subdimensions to sort participants and provide an additional nuance through which to analyze results.

Phase 2: Open-Ended Survey

The second phase of this project, an open-ended survey, rectified some challenges with the pilot interviews. The pilot phase prompted learners to engage in informal, though not necessarily self-directed, learning. My prompting them to engage *in learning*, though with the right intentions, may have diminished agency, not increased it. This open-ended survey, instead, asked learners about a time they *self-taught*, engaging them in retrospection. I specifically asked open-ended questions regarding the resources and strategies employed when learners perceived themselves *successful* as well as about who learners involved, and why. This is not a reflection of

actual learning; rather, this dissertation focuses on perceived learning, understanding learners' perceived growth or ability to do something they could not before (Boileau, 2011). This survey also included measures of learners' state motivation, affect toward content, and scales of metacognitive awareness; each is regarded as a learning outcome in formal contexts, but may be presumed in informal contexts. I include these variables to systematically sort and compare participants. In this section, I describe the procedures and participants.

Procedures

To build an instrument that explored self-teaching experiences, I combined questions focused on learners (i.e., motivations), learning (i.e., processes and control), and perceived affordances with existing scales on intrinsic motivation, affect toward content, and metacognitive awareness to capture learning outcomes. I selected an open-ended survey to collect a substantial dataset at the expense of probing or follow-up questions. Steps were taken to ensure the instrument collected valid and reliable data.

Prior to IRB approval, I pre-tested the potential instrument. Through an iterative process considering new results and pilot interviews, I revised the instrument concurrently with the testing, so participants saw the most up-to-date version. Test participants were 23 volunteers (e.g., friends, relatives, colleagues) and included 15 women, seven men, and one gender nonbinary individual; 20 white/Caucasian, two Latino/Hispanic, and one Asian/Pacific Islander; 10 currently enrolled students (two seniors and eight graduate students); and ranged from 21-52 years in age (M = 30.8, SD = 7.54). These participants completed the open-ended survey in October 2020. The first five volunteers received the instrument and no added context. They were to take the instrument as it was written. After, I met with and debriefed these five volunteers during 20-minute follow-up, live sessions. We discussed survey questions, flow, and fatigue.

These volunteers pointed out issues regarding wording, double-barreled questions, and the repetitiveness of the intrinsic motivation scale as issues. I made changes accordingly, such as shifting from the intrinsic motivation scale to a state motivation scale to capture learners' motivation regarding the learning experience and not the task itself (Frymier, 2016). The next 10 participants completed the instrument and engaged in text-based discussions (e.g., email, text messages) regarding potential improvements. The remaining volunteers took the survey and offered general comments.

After pre-testing and using the last revised version of the instrument, I received IRB-approval to collect data (IRB0003340). Data collection occurred for two weeks in November 2020. I recruited participants using Internet distribution through social media (e.g., Facebook and Twitter) or email listservs (e.g., university or professional organizations) (see Appendix F). Participants volunteered by clicking the link within the recruitment message and were first presented with the informed consent; clicking to proceed indicated consent. Participants were prompted to think of a time they taught themselves new information (e.g., basics of architecture), a new skill (e.g., cooking), or a combination of the two (e.g., rewiring an outlet) (Gibbons & Phillips, 1982). Participants were presented with three pages of open-ended questions, regarding 1) the process of self-teaching (three questions), including strategies and learning benchmarks, 2) resources used (two questions) and who was involved and why (two questions), and 3) a determination of success (three questions). Instructions prompted participants to include 2-3 sentences to help their experience be clearly understood. Participants also answered a single item regarding their perceived learning success ("I was successful in teaching myself {Q1}."), completed measures of state motivation, metacognitive awareness, and affect toward content. Last, participants provided demographics (see Appendix G for full instrument).

While open-ended surveys typically lack social cues, opportunities to prod in real-time, and rapport-building strategies (Bowden & Galindo-Gonzalez, 2015), they offered advantages for this dissertation program. First, I was able to gather a greater breadth of experiences than possible through in-depth interviews. Second, this method allowed participants space and resources to respond (James, 2016). Because participants were asked about a past learning experience, the scope of potential experiences was wide; some learners detailed multi-year learning processes that required time to explain while others explained learning that occurred over the course of 24 hours. Third, respondents did not have to respond immediately; they could formulate deep and insightful answers without concern for social validation or legitimization (Schiek & Ullrich, 2017).

To help curb some deficits of open-ended surveys, I added measures of state motivation, metacognitive awareness, and affect toward learning. These metrics allowed me to gather multiple data types that were later used to sort and compare participants. I measured state motivation to capture individualized perceptions of motivation. Further, I used the state motivation and affect toward content scales to form groups and sort participants. State motivation split into three groups (i.e., low, medium, high) and affect into two groups (i.e., low, high). I then compared responses within and across groups. Though these groups do not show in future results, they prompted my analysis.

I combined qualitative and quantitative methodologies during phase two. The open-ended nature of the survey granted participants latitude in what they discussed and how much they discussed it. I used quantitative methods to reveal and account for relationships between variables, specifically learning outcome variables (i.e., motivation, affective learning, cognitive

learning). This combined use captures more fully the complexity of SDL (DeCoster & Lichtenstein, 2007).

Instrumentation

State Motivation

Participants' motivation during self-teaching was measured using 12 pairs of bipolar adjectives (e.g., "excited/not excited" or "aroused/not aroused") on a 1-7 semantic differential scale (Christophel, 1990). Items were recoded so higher values indicated more motivation. This scale had a reliability (Cronbach's α) of .85.

Metacognitive Awareness

Self-regulation was measured using five dimensions assessing metacognitive awareness (Schraw & Dennison, 1994). Metacognition is the act of thinking about thinking and is a major facet of self-regulation (Nilson, 2013). The original scale measured regulation of cognition and knowledge about cognition. Only the regulation of cognition was measured as the purpose was to capture *control* and not motivation. This is composed of five subdimensions – planning, information management strategies, comprehension monitoring, debugging strategies, and evaluation – all measured on a Likert-type scale with 1 = *not at all like me* and 5 = *exactly like me*. Items were written to reflect a self-teaching environment and were recoded so higher numbers reflect more metacognitive awareness. Individual subdimension reliabilities are presented here and in Table 2.

Planning was measured using 7 items (e.g., "I pace myself while learning in order to have enough time") and had a reliability (Cronbach's α) of .72.

Information management strategies was measured using 10 items (e.g., "I slow down when I encounter important information") and had a reliability (Cronbach's α) of .67.

Comprehension management was measured using 7 items (e.g., “I ask myself periodically if I am meeting my goals”) and had a reliability (Cronbach’s α) of .69.

Debugging strategies was measured using 5 items (e.g., “I change strategies when I fail to understand”) and had a reliability (Cronbach’s α) of .50. This subdimension was not retained for future analysis.

Evaluation was measured using 6 items (e.g., “I ask myself if there was an easier way to do things after I finish a task”) and had a reliability (Cronbach’s α) of .73.

Affect Toward Content

Learner’s affect toward the content was measured using a single dimension of McCroskey’s (1994) Affective Learning Measure. Learner affect is likened to learner value (Hess, 2015), which this dissertation has identified as important. This 4-item uses a 7-point semantic differential response set (e.g., “valuable/worthless”) as learners consider the content they learned during the experience. This scale had a reliability (Cronbach’s α) of .74.

Participants

The open-ended survey combined convenience, volunteer, and snowball sampling (Marshall, 1996). While college students are, or can be, self-directed learners, not all self-directed learners are college students; thus, while those in the pilot study offered valuable insights, it was necessary to extend beyond just college students (Conley & Yun, 2017). I recruited participants by using social media (e.g., Facebook, Snapchat), public announcement listservs (e.g., NCA, with approval), and university listservs (e.g., undergrad- and graduate-students).

Respondents were 255 individuals at least 18 years in age who could recall at least one instance of self-teaching. I elected to include partial responses during early analysis so long as

they completed at least the first page of questions (i.e., process of self-teaching, including strategies and learning benchmarks). Of those collected, 62 (24.31%) did not meet this minimum criterion, were not coded, and were eliminated from the dataset. The remaining responses included 39 (15.29%) partially complete (i.e., participant dropped out after the first page of questions but before the end) and 154 (60.39%) complete responses including demographics; these 191 responses were retained for initial coding. Participants were majority women (89, 57.79%), White/Caucasian (130, 84.42%), currently enrolled at an institution of higher education (115, 74.68%), and ranged in age from 18-70 (M = 28.97, SD = 12.33); participants reported their highest degree earned as 69 (44.81%) high school diplomas, nine (5.84%) Associates degrees, 37 (24.03%) Bachelor's degrees, 22 (14.29%) Master's degrees, 14 (9.10%) Terminal degrees, and three (1.95%) who self-defined (see Table 1 for complete demographics). Participants reported above average state motivation (M = 5.95, SD = .75) and affect toward content (M = 6.42, SD = .66). Overwhelmingly, participants perceived themselves as successful in their self-teaching. (See Table 2 for means and standard deviations of variables.)

Table 2

Means and Standard Deviations of Variables

	Mean	SD	Min	Max	α
Learning Success Determination	6.07	1.29	1.00	7.00	-
Motivation	5.94	.76	3.00	7.00	.85
Metacognitive Awareness					
Planning	3.57	.77	1.86	5.00	.72
Information Management Strategies	3.96	.54	1.80	5.00	.67
Comprehension Strategies	3.77	.68	2.00	5.00	.69
Debugging Strategies	4.26	.54	1.80	5.00	.50
Evaluation	3.57	.84	1.00	5.00	.73
Affect toward Content	6.41	.66	4.50	7.00	.74

Learners described several unique experiences, with some describing the same topic (e.g., multiple people learning to crochet, learning an instrument, etc.) and others describing unique experiences (e.g., doing a tax lien sale, training a horse). To ease analysis and reduce the number of individual topics, descriptive codes were applied to learners' topics. This coding process collapsed similar topics (e.g., Korean cooking = cooking) and combined like topics (e.g., dog grooming and horse training under *animal-related*). Constant comparison was used to ensure topics were matched with similar topics (Charmaz, 2014) until 13 categories remained that described the topics learned. I coded topics mentioned by multiple participants together and used *other* if the topic was mentioned by only one person. (See Table 3 for a breakdown and frequency of topics taught.) In some cases, participants listed more than one topic. If so, I coded each listed topic separately, which yielded 238 topics. Given the prominence of learners' self-teaching topics, these will be used in place of pseudonyms for attribution.

Data Analysis

Data analysis occurred in several, iterative cycles, with individual RQs serving as the framework for each cycle. While each RQ necessitated a unique coding scheme, which will be described in detail below, some steps were consistent across each cycle. First, data were coded using Atlas.ti. Second, I applied open coding until a coding scheme emerged, at which point, early categories were removed or revised (Saldaña, 2013). Third, through constant comparison, data remained grounded in the participants' comments (Corbin & Strauss, 2008). Fourth, I used an iterative approach that promoted a combination of description and interpretation (Luker, 2008; Tracy, 2013). Fifth, I used a constant comparative method by cutting units of analysis into individual slips of paper to ensure coded groups were consistent and that codes were consistently

applied. Sixth, I wrote analytic memos to capture early observations and findings, which fueled later stages of analysis (Gibbs, 2007). These six steps existed across coding cycles.

Table 3

Categories and Descriptions of Self-Teaching

N	%	Topic Category	Examples of Category
38	24.68%	Creative Arts	art, digital art, knitting, crocheting, sewing, embroidery, breakdancing
28	18.18%	Household	home repairs, wallpapering, tiling, cooking, baking
18	11.69%	Musical Instrument	playing piano, guitar, ukulele, drums, etc.
17	11.04%	Academic	content is primarily academic or supports academic achievement
16	10.39%	Computer Coding/Software	computer programming/coding (e.g., Python, C+) and software use (e.g., Excel, Publisher)
12	7.79%	Vocation	auto work, mechanical work, carpentry/construction
5	3.25%	Game(s) Related	activities for successful completion of a game
5	3.25%	Other	building an accredited program for a university, doing magic/card tricks, personal budgeting
4	2.60%	Foreign Language	new language acquisition (e.g., Spanish, Japanese, Albanian)
4	2.60%	Body Related	braiding hair, makeup
3	1.95%	Animal Related	grooming, training
2	1.30%	Computer Hardware	building a PC
2	1.30%	Recreation	hunting, fishing, sailing

With these steps in place and after starting with open coding, I adopted new coding methods that were appropriate for each RQ. To answer each question, I started with a clean and uncoded document; this meant the codes of one question were not visible for another (e.g., what was coded for *affordances* was not shown when coding *motivation* or *regulation*). This resulted in several unique coding methods used between cycles. Each is explained below.

For data regarding learner motivation, I applied descriptive coding followed by focused coding. This project presumes a distinction exists in learner motivations between formal and informal contexts, and by understanding how learners satisfy their basic needs, we can better understand these distinctions. Employing descriptive coding provided me a topical inventory;

these descriptive codes were then aligned to one of three basic needs (i.e., autonomy, competence, relatedness): I coded anything addressing learner control under *autonomy*, anything addressing learner assessment under *competence*, and anything addressing relationships (or the lack thereof) under *relatedness*. I next used focused coding to narrow down to the most salient categories while remaining grounded in the dataset. The results were individual codes addressing how learners satisfy their basic needs during self-teaching.

To analyze the research question on self-regulation, I began with process coding. During this pass, I was specifically searching for actions learners took while learning. Process coding applies -ing words to identify larger processes or actions. I simultaneously used holistic coding to apply a single idea to larger sets of text. Process coding highlighted the control of SRL, where learners had to apply specific behaviors to progress. The use of process code has precedent in literature on self-regulation in the formal space (see Zimmerman & Pons, 1986), providing a similar framework for future comparisons. In the scope of this study, process coding and holistic coding allowed recognition of macroprocesses while other coding methods revealed the microprocesses.

After completing data analysis using process and holistic coding, I applied subcoding to the holistic passages to break them into smaller chunks and identify microprocesses. Subcoding allows researchers to develop sub-categories (Saldaña, 2013). In short, within the larger and holistic code *affirming*, other individual actions were identified through subcoding. The individual processes were refined and/or collapsed as analysis continued, resulting in a parent code and several sub codes (e.g., *building confidence; comparing [internally]; developing muscle memory*) indicating specific actions of affirming behaviors.

To analyze data and answer the question regarding perceived affordances, I employed an initial open coding process. Open coding was best as a starting point as it allowed the data to be broken down, examined, and compared for similarities and differences (Saldaña, 2013). During open coding, I observed that individuals regarded certain technologies as better than others. To best capture this, I applied evaluation coding to identify how learners evaluated certain learning tools. After completing analysis using evaluation coding, I used focused coding to locate the "most frequent or significant codes" from the data to identify the "most salient categories" (Saldaña, 2013, p. 213). Three perceived affordances emerged.

Analysis for RQ 1-3 resulted in several smaller codes, each assigned to one area of this project (see Appendix H). Overlap appeared between codes in various columns (e.g., confirming as evaluating aligned with evidence of learning as competence). Pattern coding was applied to the full dataset as a way of grouping participants together based on similar motivations and processes (Miles et al., 2013; Saldaña, 2013). Doing so met what Jaccard and Jacoby (2010) called a "bottom-up" approach to model building, where analysis began with the concrete processes that contribute to general themes. These general themes coalesced around four distinct groups with notable differences regarding learning strategies, understandings of motivation, and affordances. These patterns provide holistic snapshots of learners in self-directed contexts that contributes to the model developed from this project.

Various steps were taken to prepare data for this write-up. First, I cleaned responses for errors in capitalization (e.g., youtube to YouTube), punctuation (e.g., adding ending punctuation), or spelling (e.g., letters transposed). Second, I identified what survey participants taught themselves to provide relevant context. Third, and throughout the results, I use italics to denote codes and subcodes, and place attributions in [brackets].

CHAPTER 4: RESULTS

The purpose of this study was to explore how learners satisfy their basic learning needs (i.e., competence, relatedness, and autonomy) in informal, self-directed learning contexts, the processes used to control learning, and the affordances perceived by learners using several learning resources, including ICTs. Self-Determination Theory (Deci & Ryan, 2000), which served as the framework for this project, claims intrinsic motivation is a product of students' meeting their basic needs for autonomy, relatedness, and competence. Findings provide further support for the tenets of SDT with respect to informal, self-directed learning contexts; however, findings demonstrate variability regarding learners' processes and motivations.

These results are organized into two sections: first, findings elucidate three key affordances gleaned from participants' experiences during SDL: *accessibility, personalizability*, and *adaptability*. These perceived affordances label possibilities for action available within learning tools. Following this, two major themes regarding how learners assess competence and involve others are presented holistically. Though these themes, coupled with perceived affordances, vary based on how learners approach learning, their existence across groups illustrates important similarities.

The second part of this results section proposes and explains a *Lanes of Learning* (LOL) model of SDL (see Figure 5). Because SDL can be implemented in both formal and informal contexts, understanding the latter may reveal strategies for the former. Analysis of 154 completed responses revealed differences in how learners control learning, assess competence, and involve others. These differences are depicted as four *lanes* or approaches to learning in informal, self-directed contexts. Importantly, this model does not delineate learner types; rather,

this model illustrates how learners approach learning, how they collect competence cues, and how they involve others during learning.

Perceived Affordances

Perceived affordances label possibilities for action tied to the context and derived from users' evaluations of what learning tools make possible. Because SDL is individualized, despite multiple learners using the same resource, perceived affordances vary. Affordances are not tied directly to technologies or learning tools but are perceived by users in the moment. Thus, though participants used a wide array of learning tools, including videos (*N* = 68, 44.16%); various online resources such as websites, forums, etc. (*N* = 25, 16.23%); books (*N* = 10.39%); interpersonal interactions (*N* = 7, 4.55%); and social media such as Snapchat and Pinterest (*N* = 6, 3.90%), not every learning tool was linked with the same affordance.

Three primary affordances were perceived by users and emerged during analysis: *accessibility* (including *to fast material*, *to quantities of material*, and *to quality material*), *personalizability* (including pre-determined preferences for *visual* and other personally *individualized* resources), and *adaptability* (including *manipulating* or *mimicking* the resource). Each affordance, including subthemes, is expanded upon below.

Accessibility

The first affordance revealed during analysis is the possibility of access, or *accessibility.* Learners valued learning resources that provided access *to fast material*, *to quantities of material,* and *to quality material*.

To Fast Material

Participants (*N* = 18, 11.69%) regarded *access to fast material* as important while self-teaching. Participants evaluated some learning tools as providing access immediately when they

need it. For instance, one participant who learned to knit explained, “The [embroidery] kit was really helpful because it had everything I needed and I didn’t have to research all of the different supplies, which was best quality, create a design, etc.” [embroidery]. Understandably, participants sought access to materials that would provide them the solution without the caveat of extra work. When learning the piano, one learner relied on piano books inherited from siblings: they “added the entire method on how I played” [piano] – if these books were good enough for older siblings, they were enough for this learner as well. In one case, a learner noted the most valuable learning tool was “the [programming language] documentation” because “it documents what everything does” [coding], cutting down the work the participant had to do.

Participants also valued tools that allowed them to start without delay. In one case, a participant used a playset in his backyard for access to stability [unicycling] while in another case, a learner would not have learned boxing without access to the martial arts studio down the street. In both situations, participants perceived learning as accessible because a learning tool was quick and convenient. A participant who self-taught directing a play turned to videos depicting common cheerleading routines because the play being directed included cheerleaders; by utilizing videos in this way, the learner was able to include relevant material. Overall, a learning tool was perceived valuable when it made learning immediately possible.

To Quantities of Material

Learners (*N* = 18, 11.69%) valued learning tools that granted access *to large quantities of materials*. Participants acknowledged tools that provided access to many possible sources. One learner described a specific tool, YouTube, as a “first pit stop:” “There are 100,000 tutorials on YouTube for anything and everything. If there is something I wanna [sic] know or learn, my first pit stop is YouTube” [building a PC]. This learner indicated the vastness of options available was

an important factor not just to visit YouTube for one challenge, but for all. Several participants echoed this sentiment, with one going so far as to argue YouTube can help with "anything from switching out a brake light to how to solve logarithmic equations. It is helpful because there are always a lot of options to choose from" [replacing a brake light]. This, of course, is not unique to YouTube; learners valued access to large quantities of examples or tutorials whether through books, websites, social media, etc. because then they are "never out of information" [embroidery]. Learners who valued quantities of materials prioritized finding something over finding the right thing.

One benefit of access to large quantities of sources stems from what one participant referred to as a "seemingly endless reference library" [digital art]. As such, for several participants, "if one tutorial wasn't helpful, there were dozens of others" [crocheting]. Large quantities of learning materials meant learners could tie together various perspectives. A participant learning to build a deck explained this as "watch[ing] a bunch of videos and [taking] ideas I liked [from] them" [deck building]. Access to large quantities of resources meant learners could pick and choose content or "take the best pieces of each video and make yours better" [neutering a cat]. Access to large quantities of material allows learners to "either find one search result which helps me learn what I need to learn or pull information from multiple search result pages and merge it all together" [polynomials]; more so, learners could access "so many links to blogs and websites" and receive from each "a little piece of knowledge. I just had to tie it all together" [embroidery].

To Quality Material

Along with tools providing access to the fast resources or to many resources, participants (*N = 31*, 20.13%) expressed that *quality*, too, was important. Access to quality information is

best surmised as that which provides a *clear* answer to a learner's question or unique needs. Learners valued their ability to not just find resources, but answers. Clarity was an important indicator of quality, and as one learner explained, was possible because some resources "almost always had an exact answer to a question I had" [computer coding]. Learners valued access to insider knowledge, achieved when learners felt they gained information otherwise unavailable: "The online forums were the most helpful because people included shortcuts or hints – like how to remove a particular piece of the bumper to be able to get behind the foglamp easier" [fixing a Humvee]. Learners who valued quality sought resources that provided a type of insider knowledge that was otherwise unavailable. For example, one participant "lurked on a Korean food subreddit, where someone has a running post of 'My Daily Korean Lunch' or something like that. This was interesting to see how different their cafeteria lunches are, what items appear, and to learn new recipes" [Korean cooking]. By lurking, this participant accessed quality, insider information (i.e., more authentic menu items and thorough lists of ingredients), a pivotal aspect in learning. When a learning tool provided access to quality information, learners could find "suggestions to the issues you are having. I never submitted my issue to the website, but it was usually there if I looked hard enough" [computer coding]. Quality was achieved through clarity.

Participants also valued access to experts or experts' resources. Multiple participants commented that learning tools could provide access to, as an example, "an actual music teacher" [piano] or to an expert who has experience:

> Expert's blog is particularly helpful. It provides you with concrete examples, so that it is easy to understand and relate. […] I talked with one lady who bought two houses at the tax lien sale before. She was nice, telling me what she prepared for the sale, what website she used, and how the process worked. I got some useful info from her. [tax lien sale]

Learners appreciated when the person on the other end could speak from experience. For instance, one learner "focused on blog posts or articles from people who had also taught themselves, sharing their initial mistakes and misconceptions and how they overcame them" [sewing]. Access to *experts* was often mediated by technology, but this also meant the number of accessible experts increased. One participant used an online Discord server to find people who had more experience, and because they "have been doing digital art much longer than I have" [digital art], their contributions were perceived as high quality.

Personalizability

A second perceived possibility from the learning tools used during self-teaching is *personalizability*. Personalizability was perceived when learners felt the learning tool allowed them to learn "on my own time, my own terms, my own ideas" [quilting] without having to actively change or adapt the tool. Participants evaluated highly learning tools that met *individualized* needs; a prominent example of this is use of learning tools that made learning *visual*.

Individualize

Participants (N = 27, 17.53%) valued learning resources that were individualized to match their unique circumstances. One learner stated specifically, "[YouTube] was like I had my own private tutor but for free" [piano]. Learners found public platforms that allowed for a feeling of increased individualization. Participants wanted to find resources that "worked best for you" [aerial silk acrobatics] as these would most closely link to their learning goals. One participant offered an apt explanation of a learning tool making possible individualization:

> I do not see value in learning anything unnecessary to accomplishing [sic] my goal. I did not read any music theory books, or even beginner guitar books. I believe those would

> have bored me and lost my interest in learning guitar. Instead, I googled or looked up a YouTube tutorial on any question or problem I had. This made learning fun because I was only learning things that I wanted to learn.

The idea the learning tools could meet individualized needs meant she learned only what she wanted, personalizing her learning experience.

Participants perceived an individualized experience when the material was in their challenge range. For some participants, moving to self-teaching was a result of overcomplicated instruction elsewhere, placing increased emphasis on finding tools that worked for them. Several learning tools afforded this, whether by channel – "The information [on YouTube] is extremely accessible and meets you where you are…" [guitar] – or individual resource – "[Sal Khan] doesn't talk about things that go over the viewers head…" [computer coding]. Important here is the *valence* assigned to a resource. Affordances are perceived by the users in their unique contexts, so a resource that is perceived as good for one learner could be the antithesis of learning for another. It was not about the tool, but about what the tool provided, specifically, for the learner. For example, participants labeled the positive and negative valence of *books* – "Books are key. They are guides to success. Without them, I can still learn but it takes much longer with more trial and error" [rebuilding complex engine components] – "I can learn new stitches now from books, but […] the 2D nature of books made it hard to figure out exactly how everything should look or the movements of the crochet hook" [knitting]. Learners did not evaluate *books* but the learning experience made possible by books.

Visual

Some learners (N = 18, 11.69%) preferred tools that allowed for visual learning. Acting on this preference achieved personalization. One participant captured this: "I am the kind of

learner who needs to see something to be able to do it" [quilting]. Learners explained the ability to watch individual steps and "having someone show rather than tell was helpful" [knitting]. Even more importantly, learners wanted to have visual clarity rather than relying on assumptions: "I was able to see the steps being done in front of me without trying to imagine what is going on" [solving Rubik's cube]. One learner explained that "without the videos to see how to do it, I wouldn't have known what to do" [dog grooming]. Some participants in this study identified learning tools that provided them these visual resources as more valuable than others. With visuals, learners could verify their work before they considered it complete: "I like learning by using visuals so it helps me feel confident when I can see the process to ensure I am accurate throughout" [sewing]. In doing so, the learning tools provided opportunities to personalize the learning experience.

Adaptability

A third major affordance is perceived *adaptability*. Adaptability refers to levels of flexibility available by the tool for the learner, specifically in a way that helps the tool adapt to the situation. Flexibility was noticeable when participants *manipulated* a tool (e.g., starting or stopping); in some cases, participants used manipulation to *mimic* a resource in real life.

Manipulate

Learners (N = 25, 16.23%) explained a perceived value in technologies they could actively control (i.e., actions such as fast-forwarding or rewinding, slowing down or speeding up, stopping or (re)starting). The benefits wrought from manipulating learning tools meant learners could "watch the instruction over and over again" [drawing], "…can replay, pause, and slow down videos to watch more closely" [breakdancing], and can "rewatch as many times as needed to master a particular skill" [sewing] before ever attempting it – all in the name of their overall

learning. One learner paused videos to gain a closer "look at hand positioning along with the hook's positioning to figure out how to do it" [crocheting]. Two participants, both who self-taught crocheting, demonstrate how manipulation is not tied to a specific tool but is perceived as an affordance of a tool: the first used books because "unlike a video I could read and try things at my own pace;" the second "found it very helpful to change how fast the video was going so I could watch the technique in half speed so I didn't miss anything." Put explicitly, learners valued "the ability to digest the information at my own speed" [playing a game], a consequence of manipulating learning tools.

Mimic

Some participants (N = 17, 11.04%) prioritized manipulation with a goal of mimicking the resource in real life. The potential to *mimic* was an add-on to manipulation: learners could watch clips and then try it, either in real time or after the fact. To illustrate, one participant "used YouTube to watch chefs like Gordon Ramsay and Jamie Oliver cook recipes and followed along," which allowed this learner "to watch exactly what those chefs did and then learn why they did that" [cooking]. Mimicking transformed the abstract into the concrete, as exemplified by one participant who explained "[autobody work] was something you had to physically learn so I didn't rely on [YouTube] too much." Watching the video was only a start; this learner, to really learn autobody work, practiced on the cars, applying what he was learning from the videos in real time.

Learners valued technologies they could watch now and mimic later. One learner who was attempting to break a horse explained the importance of videos that could be mimicked later: "I used instructional videos by Buck Brannaman. They were my only resource in the actual training, and they were indispensable. They taught me step by step how to complete each task

with my horse" [training a horse]. By watching, applying, and then watching more, this learner ensured success. Select participants went one step further and "surrounded myself with it and put it on all of the computers, which forced me to learn it faster" [using Linux] or changed their "phone into the foreign language that I was learning. What made that resource helpful was that I was forced to use the foreign language everywhere on my phone" [foreign languages]. In mimicking as such, learners were always learning.

Section Summary

Participants perceived three affordances from learning tools during SDL: *accessibility* (including *to fast material*, *to quantities of material*, and *to quality material*), *personalizability* (including resources being *catered* or being *visual*), and *adaptability* (including the ability to *manipulate* and, at times, a goal to *mimic* the resource). A summary can be seen in Table 4.

Table 4

Affordances Codes and Examples

Affordance & Subcodes	Example(s)
Accessibility	
To Fast Material (N = 18, 11.69%)	"The kit was really helpful because it had everything I needed and I didn't have to research all of the different supplies, which was best quality, create a design, etc."
To Quantities of Material (N = 18, 11.69%)	"YouTube, YouTube, and YouTube. There are 100,000 tutorials on YouTube for anything and everything. If there's something I wanna [sic] know or learn, my first pit stop is YouTube."
To Quality Material (N = 31, 20.13%)	"The online forums were the most helpful because people included shortcuts or hints – like how to remove a particular piece of the bumper to be able to get behind the foglamp easier."
Personalizability	
Individualize (N = 27, 17.53%)	"[YouTube] was like I had my own private tutor but for free."
Visual (N = 18, 11.69%)	"I was able to see the steps being done in front of me without having to imagine what is going on."
Adaptability	
Manipulate (N = 25, 16.23%)	"I think they're invaluable when it comes to attempting new projects! I'm able to pace myself as I thoroughly follow the directions as well as pause and start the videos…"
Mimic (N = 17, 11.04%)	"…phone into the foreign language that I was learning. What made that resource helpful was that I was forced to use the foreign language everywhere on my phone."

Major Themes

This study sought to understand how self-directed learners (i.e., motivations) approach self-directed learning (i.e., processes) (Hiemstra, 1994). Analyses led to the formation of a *Lanes of Learning* model (see Figure 5), which holistically presents self-directed learners' processes and motivations in learning. Before this model can be effectively explicated, two primary themes surrounding learners' basic needs must be articulated. The first examines how learners assess *competence,* and the second addresses how learners choose to involve others in their learning.

Competence

To satisfy their need for competence, learners gathered internal and/or external evidence of learning (i.e., competence cues) throughout the learning process. Meeting a need for competence occurs when learners feel mastery at optimal challenge while receiving clear feedback regarding level or ability. In a formal space, this may be a test or a project, assessed by an instructor, who provides a metric of success; in self-directed, informal contexts, a similar metric is gathered without an instructor. Learners initiate, perform, and assess learning independently, which means no formal assessments need occur for learners to perceive competence. To analyze competence throughout SDL, learners were asked about competence along the way (e.g., "How did you know you were making progress?") as well as at the end (i.e., learner perceived success). Analysis revealed learners gather evidence indicative of what they know and can do; these *competence cues* fell into two categories: *confirming* and *affirming*.

Confirming Competence Cues

Participants gathered confirming competence cues, or quantifiable evidence derived from some external entity, and used them to apprise themselves of their learning. Confirming cues provided tangible proof of learning, as best exemplified by a participant who confirmed his

learning by “looking up past AP Computer Science tests and attempting the test. I later asked my school’s guidance counselor if I could take the test even though I didn’t take the course, and I ended up taking the exam and passing” [coding]. Participants gathered confirming cues by identifying *visible* and *immediate* effects, seeing confirming cues as *proof* of learning, and *comparing* (externally) to one’s previous and to other experts’ work.

Several participants indicated they identified *visible* and *immediate* signs of learning progress. Naturally, this was increased for learning topics with a physical product (e.g., creative arts, musical instrument, etc.) or that required labor (e.g., home repairs, vocational or recreational activities, etc.), but participants describing academic topics or procedural learning also noticed visible and immediate signs of learning. Participants, such as one who learned to make an Amish toothbrush rug, noted visible evidence made it easy to assess competence:

> One of the great things about a craft like this is that the progress is very visible. I worked up from a small placemat-sized piece as a test to a larger rug and assessed progress and proficiency through the uniformity of the knots and the shape.

As the rug grew or as the knots improved, this learner gathered visible, immediate evidence of learning and, from there, scaled up. A participant explained these visible and immediate cues: “Within competitive rocket league there are ranks that indicate where you stand within the player base. I set my benchmarks by those and had goals to move up one rank each month” [playing “Rocket League”]. For this participant, ranks visibly depicted competence, and confirmed learning because they appeared immediately during play.

Participants pinpointed indicators of learning that allowed them to see the tangible *proof* of learning. To assess whether progress was being made, participants often referred to the obvious: “whether I could play exercises or songs or not” confirmed or disconfirmed learning

[playing a drum set]. In these cases, participants validated learning externally, collecting undeniable proof they successfully learned (e.g., “Finally the deck was built, looked great, and is still standing, i.e., evidence that I learned” [building a deck]). Much as this participant alludes to, it was hard for learners to argue against proof. In short, if the deck is still standing, clearly deck-building has been learned.

Another confirming cue stemmed from direct and external comparisons made by learners to their own past work as well as to the work of experts. Many participants used comparatives (i.e., -er ending) when evaluating progress. Participants made external comparisons to their past selves by “recording myself and listening to my recordings at a later date and see how much I improved” [playing banjo, guitar, ukulele, drums], to their current selves by “comparing each mask I made. Each one held together better, lined up better, had neater stitches, a more advanced design, et cetera” [sewing], and to the experts by comparing to “the online pattern progress photos and when my skirt looked like theirs, I figured I was heading in the right direction” [sewing a bustle shirt]. External comparisons helped participants proceed when other visible or immediate cues were less evident: “Sometimes, even with piles of hair swirling into my nose, it was hard to see progress. I did look at the ‘before’ photos during the process and could tell that what I was doing was making a change” [dog grooming]. Participants explained the use of external comparisons helped them identify “where I can improve or how I improved” [embroidery]. Participants made direct and external comparisons, allowing them to confirm their learning.

Affirming Competence Cues

Affirming competence cues label cues that exist internally or are internal to each learner. Affirming cues are those learners can feel but cannot touch, like an internal metric of “start[ing]

to feel like ‘I got this’” [returning to college after 20 years]. Affirming cues were more personal in that what one learner gathered as affirming did not match another. For example, a participant who initially learned to cook by relying on guides and recipes, illustrated affirming cues: “my food is just more ambitious and less structured (I don’t have to follow recipes anymore. I just dump sh*t in a pot and it’s delicious every time) or I have memorized recipes/ingredients. Progress.” A second explained “being able to keep up in conversation or the opposite (becoming lost in technical jargon) was a good litmus test for my own fluency” [Spanish]. Both learners gathered affirming cues, but what these looked like differed. Learners gathered affirming competence cues by *comparing* (internally) how learning was and how learning is (e.g., easier, faster, smoother, etc.), *building confidence*, and *developing muscle memory*.

Affirming comparisons allowed learners to draw comparisons; what separates affirming from confirming comparisons is the metric of comparison. For confirming comparisons, the learner identifies and compares to an exemplar, with some indication of what “right” is (e.g., “Business has grown, we use the furniture, I’m learning new songs and more difficult ones on the piano every week. I can see measurable progress” [starting a business, playing piano, and refinishing furniture]). Affirming comparisons, in contrast to confirming comparisons, does not involve precise metrics; several learners described what this learner captured in words: “I knew I was progressing when things became easier, and the situations didn't feel like such a struggle. There was less time on figuring out the situation and more time actually attacking it” [woodworking and mechanical work]. When learners made comparisons to some aspect of their performance in a way that was unmeasured, they *affirmed* learning.

Confidence, or self-efficacy, identifies learners’ beliefs in their future abilities. Not all learners in this study needed quantifiable evidence of success or mastery. For example, one

learner explained, “I didn’t need benchmarks to know I was learning, it is a thing like love or memory-- it's not quantifiable in itself” [dying hair]. Emphasis for this learner is on feeling mastery existed. Similarly, changes in confidence levels served as turning points for some:

> There’s a move in card magic called a force. It’s where you make someone pick a specific card. There’s lot of different forces. Some of [them are] pretty easy. The first time I made someone pick an intended card, it really opened up a whole new world for me in terms of my confidence and what I felt like I could learn and do. [card magic]

As described, this learner’s momentum shifted after mastering one specific move. That internally felt affirmation meant he could confidently engage in more difficult follow-up learning. Confidence for some manifested not in correct answers but in correct logic: “When I can work through a problem beginning to end…even if I may not have the right answer, I know I’m starting to follow the logic” [new analyses for data]. When participants felt increased confidence, they felt affirmed in their future abilities.

The pinnacle of affirming cues was developing muscle memory. This was the difference between thinking about learning happening, and it happening naturally. As one learner described, “I realized I was learning when I began to instinctively move my feet to the correct spots and at the correct time to keep my balance” [boxing]. Learners noted this may have been from the reduced cognitive demand required to complete the task:

> The less I was actively thinking about HOW to play the guitar was a benchmark for improvement. The less you think about HOW to play, the better you are at playing and the less you have to play. It’s this positive and counterintuitive feedback loop that is more motor-based than intellectual. [guitar; emphasis original]

For others, muscle memory was an invisible precursor to multitasking. A participant learning to cook stated that "as time goes on, it becomes more natural; while I wouldn't say mindless, it requires less cognitive effort, an example being I could be cooking and carrying on a conversation with someone." When learners felt they had learned the knowledge or skill, they affirmed their learning by allowing themselves to know they knew the material. For example, one learner "started being able to read knitting patterns without having to look up what any of the abbreviations meant, and then eventually I could infer what they meant even if I'd never encountered them before" [knitting]. When learners ran on muscle memory, they felt increased affirmation that they had learned what they set out to learn.

Involving Others

Many participants in this study described their decisions to involve or to not involve others in their learning. Satisfying a need for relatedness, in formal contexts, is achieved when learners feel connected to their peers and/or their instructor. In informal contexts, not all learners chose to involve others (i.e., *isolation*). Those who did learn with others highlighted two reasons for this decision: for *guidance* or for emotional *support*. When learners had emotional reasons, they involved others who both shared a *language* with them and those who did not.

Not Involving Others

A first notable group of participants (N = 26, 16.88%) involved no one else during their learning. This is, of course, not surprising as self-directed learning emphasizes the agent over the group. A primary benefit of self-teaching is the option to learn in isolation, an option preferred and taken by several participants, including one who learned to sew:

> Not having any interactions was vital to my learning process. When you're learning directly from another person you have to, in general, go at their pace and rely on their

> knowledge. I have ADHD and love the ability to go at my own pace, go on research tangents, start and stop at will, consolidate and validate information from a variety of sources, and not be accountable to anyone else. The lack of interpersonal pressure makes learning a leisure activity that my brain can hyperfocus on.

Learners who chose not to involve others indicated they would have served no significant role to their learning. In contrast to learners who claimed their supportive or guiding interactions were important, learners who self-taught in isolation defined "interactions with others [as] not all that critical" [Polynomials]. Though low in proportion to the overall sample, this group of learners represents those for whom interpersonal interactions were not necessary for learner success.

Reasons for Involving Others

Participants involved others for two primary reasons: learners explicitly sought *guidance* – the 'other' served in an instructor-like role – or learners found emotional *support* – the 'other' collaborated or celebrated with but did not instruct the learner.

A first reason learners involved others was to *seek guidance*. As one participant succinctly stated, "I reached out to regional program directors and to the Director of Accreditation for *guidance*" [developing an accredited college program; emphasis added]. Participants explained they recognized the value of outside professionals; one participant captured this in a question: "How can one improve if one doesn't know what needs improvement from a professional in the field?" [dog grooming]. Throughout time, learners may receive guidance from multiple others that results in successful learning, which explains how a 70-year-old woman learned to do basic home repairs after becoming a widow: "each interaction with different people added to my knowledge." Though learners need not involve others, many chose to in search of guidance.

Guidance was best when it was received from experts. It must be noted that the expert need only have perceived expertise, not necessarily credentialed expertise. Thus, a participant who consulted a doctor to quit smoking and a participant who learned to sew by joining a ladies' sewing club both consulted experts. More important was the valued added by the other; participants sought guidance with a goal to gain necessary information. A participant who learned to play ukulele "found the right teacher on YouTube and [she] taught me the chords. Her technique helped me memorize the chords." The guidance was not synchronously delivered, and the participant did not know the woman in the video on an interpersonal level, but she provided expert information, which fulfilled the learner's need.

A second goal participants had when involving others was *emotional support*. Participants chose to involve others who could not necessarily provide guidance but did provide an incentive to continue learning. A participant learning Windows System Administration captured this dichotomy between educational and inspirational: "I think the interactions were less informative and more subjective about our approach to learning. This did influence me towards new avenues for learning (forums or Microsoft resources I hadn't yet explored) but didn't change my process significantly." Learners recognized not all others possessed the expertise to provide guidance, but "if even not directly supportive it was emotionally supportive to have [my mother] check in and ask how things were going" [sewing a bustle skirt]. The value of the emotional support varied on whether participants perceived a similar language with the others involved.

Shared Language with Others

When participants involved others with a goal of emotional support, a difference emerged for those who shared a language with the learner and those who did not. To share a language is to share meaning: learners knew the other could speak and understand their learning because they

have had similar experiences in the past. To illustrate, a person learning sleight of hand card magic who consults another magic learner would share a language (e.g., magic language; see Shoemaker et al., 2004); but, as demonstrated by this participant, a person can involve another who does not share a language:

> I would practice and then show my dad. At first he would just *oo* and *ah*, but as I progressed, he learned how to offer me meaningful feedback. Eventually (after a month or two) I got comfortable enough to show my friends, who were of course very skeptical of my 'new' hobby (finding it very lame), but they quickly jumped on board, and I was made to 'perform' at many a bar and party.

Shared language was exemplified when this participant described meaningful feedback. What started as passive placation evolved as the learner and the other developed a shared language. However, for those interactions where a shared language was not achieved, the learner could not receive anything but celebration. Sharing a language arose as a prominent concern for involving others.

Participants involved others with whom they shared a language when they needed a sounding board but not instruction. These relationships were more symbiotic, where both members worked together: "I interacted with my best friend often because we bought our ukuleles around the same time, but I didn't really interact with anyone else about it. She and I would play together every once in a while just for fun" [playing the ukulele]. In building these mutually beneficial relationships, participants felt an increased sense of community. At times, this was literal. Participants involved others who could fill in their learning network and provide relatable experiences, resulting in learners who "reached out to people that I knew who quilted already and asked lots of questions" because "everyone who quilts LOVES to share advice and

experience because quilting is a labor of love" [quilting; emphasis original]. This participant was not seeking an instructor; she already possessed the knowledge needed to quilt. What this learner found was an emotional network of other quilters. As participants gained knowledge independently, they interacted with others to form connection. One learner used a phone application to learn Pinochle, a four-player card game; only after she had acquired the language (i.e., knew the basics) would she "[play] Pinochle with my parents and a family friend. They helped me play even better by giving me tips and instructions that only seasoned players would know. I'm pretty good now!" Because this learner shared a language with her parents and family friend, she was assimilated into the group and reaped the learning benefits.

Not all learners found others with whom they shared a language, but this was not necessarily a detriment to learning. This was succinctly illustrated by a participant learning Arduino coding: "Rarely did anyone know what I was actually talking about." When this learner involved family members, they offered encouragement, not expertise. Additional participants echoed this sentiment, with one lamenting, "I often really just wanted to ASK someone, but wasn't sure who to ask" [piano, cake decorating, calligraphy; emphasis original]. No one this participant knew could speak the language of piano, cake decorating, etc.; rather, for this participant, "encouragement alone from [others involved] was very important, or I probably would have stopped." This learner, and many others, highlighted the benefits, but not the requirement, to share a language with those involved in the learning process.

Sharing a language was not a precursor to emotional support; learners still received emotional support even when others did not share experiences. A participant learning Korean cooking made this point clear by relegating her family's role to support only:

> Receiving encouragement is always nice and motivating. If my husband was not willing to be the "dumb white guy" in the Asian store trying to find the right red pepper paste, sprouts, and eomuk, things might not have continued as swimmingly. If the kids hated all the food, I might not have tried as many things or made them as frequently. I guess these things helped provide the tools for learning, and the motivation to keep going.

For this learner, no one spoke the language of Korean cooking, but others were still involved. Her children did not know the names of the food items, and her husband did not know the names of the ingredients. Both challenges were moot. This learner involved others because of the external praise to continue. This highlights the distinction between emotional support and external praise. Receiving external praise served as a form of learning confirmation despite it not affecting the learner's knowledge. One learner illustrated this point:

> I gifted my friends a lot of my early projects (simple things like scarves and headbands). They were all very encouraging even though early the finished versions weren't very good. After a few months, their reactions changed as I was able to create more complex pieces and I could tell they were impressed and not just supportive. [crocheting]

For this learner, receiving positive encouragement at first was emotionally fulfilling, but as time passed, the others could offer constructive feedback in a way that confirmed learning.

Section Summary

Two themes emerged regarding learners' satisfaction of basic needs: first, learners gather evidence of increasing competence throughout their process, and this evidence is either *confirming* (i.e., external) or *affirming* (i.e., internal). Confirming competence cues were visible and immediate, offered tangible proof, and could be compared externally; affirming cues,

conversely, are increases in confidence, internal (and unmeasured) comparisons, and culminate in muscle memory.

Table 5

Major Themes and Codes with Examples

Themes & Subcodes	Examples
Confirming Competence Cues	
Identifying immediate/ visible effects	"One of the great things about a craft like this is that the progress is very visible. I worked up from a small placemat-sized piece as a test to a larger rug and assessed progress and proficiency through the uniformity of the knots and the shape."
Seeing proof	"...the deck was built, looked great, and is still standing IE evidence that I learned."
Comparing (Externally)	"The way I track my progress is by either recording myself and listening to my recordings at a later date and see how much I improved."
Affirming Competence Cues	
Building confidence	"I didn't need benchmarks to know I was learning; it is a thing like love or memory-- it's not quantifiable in itself."
Comparing (Internally)	"…things became easier, and the situations didn't feel like such a struggle."
Developing Muscle Memory	"As time goes on, it becomes more natural; while I wouldn't say mindless, it requires less cognitive effort in [sic] example being I could be cooking and carrying on a conversation with someone."
Reasons for Involving Others	
Guidance	"I reached out to regional program directors and to the Director of Accreditation for *guidance*."
Support	"If even not directly supportive it was emotionally supportive to have her check in and ask how things were going."
Shared Language between Others	
Shared Language	"I played Pinochle with my parents and a family friend. They helped me play even better by giving me tips and instructions that only seasoned players would know. I'm pretty good now!"
No Shared Language	"Rarely did anyone know what I was actually talking about."
No One Involved	
Isolation	"Not having any interactions was vital to my learning process. When you're learning directly from another person you have to, in general, go at their pace and rely on their knowledge. I have ADHD and love the ability to go at my own pace, go on research tangents, start and stop at will, consolidate and validate information from a variety of sources, and not be accountable to anyone else. The lack of interpersonal pressure makes learning a leisure activity that my brain can hyperfocus on."

Second, learners chose whether to involve others in their learning; not all did. Those who involved others did so in the search of *guidance* or *emotional support*; when the goal was

emotionally derived, others were involved who did and who did not share a language with the learner. Learners involved *coaches* (i.e., reason: guidance), their *team* (i.e., reason: support; shared language), and various *fans* (i.e., reason: support; no shared language). A summary of these findings is seen in Table 5.

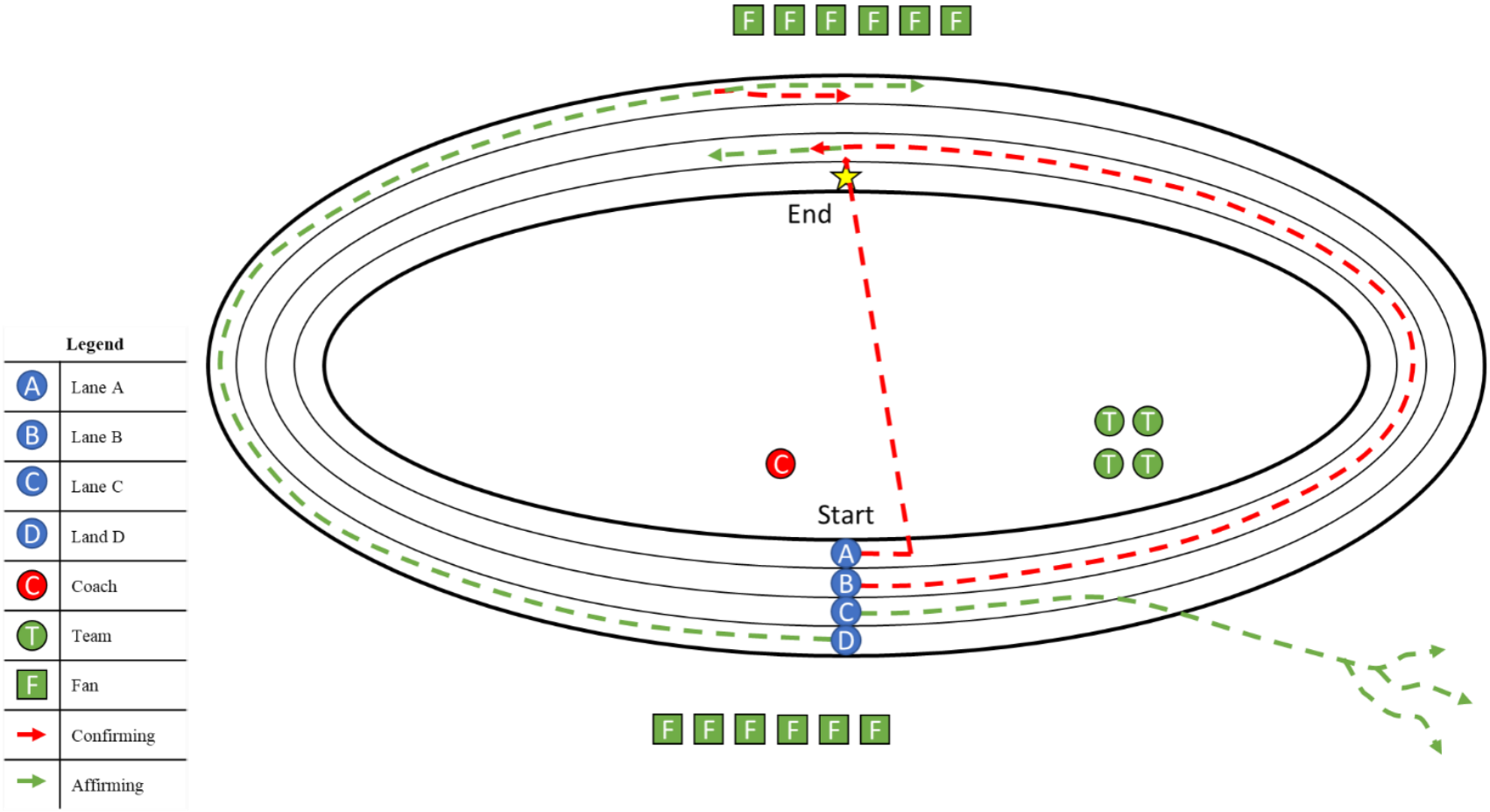
Lanes of Learning Model

In addition to competence and relatedness, when learners satisfy a need for autonomy, they may experience increased intrinsic motivation. Though in informal contexts autonomy is presumed (self-directed learners control self-directed learning), participants in this study demonstrated they may not always take full advantage of this autonomy or display their autonomy differently depending on their tendencies. Not all self-directed learners approached learning in the same way; thus, though it is easy to presume all learners in informal contexts are equally motivated and autonomous, variation exists between learners. Not all learners desire the same levels of autonomy; what's more, when learners have autonomy, they may not take advantage of it or may take advantage of it in unorthodox ways. After analyzing this data, I argue self-directed learners tend to traverse one of four *lanes* or paths to teach themselves. This model depicts self-directed learning and self-directed learners in informal contexts as varying in how they satisfy needs for autonomy, competence, and relatedness; the resulting *Lanes of Learning* model (Figure 5) provides a holistic representation of participants' processes during SDL.

The proposed model presents learners' mental schemas regarding self-teaching/SDL. Learners may take any lane they choose when beginning to self-teach, but this placement is often contingent on their goals. At this point, analysis focuses on processes and not people. The lanes

Figure 5

A Lanes of Learning Model of Self-Directed Learning.



are manifestations of learner control. Emphasis is on how learners get from *start* to *end*. Importantly, this metaphor does not suggest competition or place runners as against the other; rather, much as it would be for those using a track for personal fitness, participants compete with their own *personal records*, or what they were versus what they are versus what they want to be (i.e., change; Boileau, 2011).

Self-directed learning is both episodic and cyclical. Episodic learning means learners viewed learning experiences individually while cyclical learning is repetitive learning on the same topic (e.g., learning 120 musical instruments) or multiple topics concurrently (e.g., Japanese *and* cooking). This model suggests learners take *laps* (i.e., episodes) around the track, and what these laps look like varies by an individual's learning tendencies. Participants learning the same topic could be spread across lanes.

Laps around the track are fueled by competence cues. A clear difference emerged for learners who needed *confirmation* and those who needed *affirmation*. In the present model, *confirming* competence cues (i.e., visible or immediate evidence, proof, or external comparisons) are depicted as a dashed red line. Participants who collected confirming cues wanted external validation, and this often regarded the correctness of their performance. *Affirming* competence cues (i.e., increases in *confidence*, development of *muscle memory*, or *internal comparisons*) are depicted as a dashed green line. Affirming cues reflect emotional gains (e.g., internal metrics of 'I've got this!' or 'I can do this!'). Participants who described affirming cues valued internal validation above anything collected externally.

The proposed model depicts four mental schemas used by self-directed learners. This typology presents four lane options taken by runners, the competence cues gathered, and the

likelihood of involving others as well as the roles they fulfill. The results are presented sequentially in the next few sections by focusing on the processes taken by runners in each lane.

Lane A

Runners in Lane A (N = 39, 25.32%) engaged in self-teaching not for the sake of learning itself, but rather learned in the interest of *task completion*. Some characteristics of a learner in Lane A include wanting to move from start to finish quickly, gathering *confirming competence cues*, and determining success from visible and obvious markers. These characteristics are evident for a participant who self-taught multiple [computer] programming languages:

> I basically had a desire to make the computer do a specific thing, so I went and asked the Internet what I needed to learn to do that. Once I knew what to do, I read and memorized the entire documentation for each programming language and began to make those dreams of mine come true.

This runner embodies multiple Lane A characteristics: he reported learning only what is necessary to "do a specific thing" and made decisions to maximize the chance of finishing. During learning, this learner gathered confirming evidence when he "made the programming language do more complex tasks than simply outputting 'hello world.'" In the end, when asked how this runner knew he had learned, he claimed, "It's obvious." This participant was able to complete his tasks, and thus, completed his learning. Further, learners in Lane A took advantage of learning tools that provided some correct path or steps to follow, an indication that completion was the goal.

Runners in this lane have a target outcome or goal and make decisions to reach that goal. For example, participants described learning to unicycle, to solve a Rubik's cube, to take apart and reassemble a camera, and to solve the standard deviation of a dataset; in each instance, the

learner had an intended goal and each choice moved him/her closer to that goal. To illustrate, a participant had a goal to install a new thermostat, and to learn, "started by researching what type of thermostat I wanted. And then I used the internet to find directions on installing." Each step for this learner was sequential: first was the research and next was the directions. In Lane A, runners move from start to finish in as few stages as possible.

As a demonstration of autonomy, participants in Lane A prioritize efficiency (e.g., runner *cuts* across the grass). For instance, a participant who put together a video in premiere pro "needed to make a specific video for a scholarship prompt, and since I have an Adobe subscription, I opted to use premiere." This learner was not looking for increased skills related to video editing, broadly, but had a goal instead to learn about a specific tool that would allow completion of the task. As this learner explained, "I wasn't interested in mastering the program. I had a specific output in mind, so I catered to those specifically identified needs and ignored the majority of the program." Runners in Lane A satisfied their need for autonomy through strategic decision-making not to maximize learning but to maximize the rate of completion. A participant self-teaching how to trim and transition hardwood to carpet explained a process built on efficiency: "I started with researching it online, then watching tutorial videos online. I started by measuring out the areas needed to cover or transition. Made the cuts according to measurements and finished the process with recommendations according to tutorials." This learner did not trim and transition beyond what was needed to complete the task. When asked to determine his success, he answered, "the carpet transitioned nicely to the hardwood and my wife was satisfied with the outcome." This learner was not seeking broad home construction skills, but rather sought a solution to an at-hand project (i.e., a task).

Runners in Lane A defended the short-term impacts of finishing a task; for them, this manifestation of autonomy was not a detriment, but an asset. One participant explained his broad approach to learning:

> I start by either reading or watching a video; videos are a lot easier to understand and stay focused. After that I try it myself and that's basically all I do. I usually only teach myself to complete something so I might complete an assignment or a test. [building a desk]

This participant was less interested in broad carpentry skills and more interested in the immediate gains of having a desk. In this instance, building a desk was an assignment, something this learner had to get done. Because runners in Lane A were not always seeking long-term gains, many absolved themselves to short-term solutions. For instance, one runner "wanted to tile my bathroom and didn't want to pay someone to do it" and decided that "however it turns out is 'good enough'" [tiling].

Runners in Lane A gathered, predominantly, confirming competence cues. A participant self-teaching tiling identified the confirming cues collected while learning: "If I finished the project, that was my benchmark for success. If I made fewer mistakes and wasted less tile, that was progress." Lane A runners assessed competence by evaluating the results of the task, such as a participant learning content for the GRE who, after consistently achieving higher scores on practice tests, "passed the test with a score higher than the score I aimed for" and took that as a signifier of success. When asked to determine learning success, participants in Lane A pointed to visible accomplishments: "well, my brake lights work now sooooo" [changing brake lights]. Confirming cues ensured learners in Lane A made it to their designated *end* (i.e., finish line).

Overall, runners in this lane were more likely to involve others who served functional purposes before emotional. Most learners in Lane A involved others (see Table 6 for summary).

Though this group prioritized task completion, only four (10.26%) learned in isolation; of the remaining runners in this lane, 15 involved *coaches* (38.46%), 11 involved *fans* (28.21%), and nine involved their *team* (23.08%). That so many runners in Lane A involved a coach is not surprising: runners in this lane recognize the value of "problem-specific feedback" that was provided by those with more knowledge [tiling]. One participant learning to cook explained that interactions with her mother were "key to my learning process as I learned what to use and she helped me brainstorm ideas for what I could cook." Runners in Lane A who involved a coach deemed the interactions as incredibly important. When Lane A runners involved members of their *team* or *fans* (i.e., emotional support), the interactions were important in different ways. As one learner explained, "I interacted with a variety of students and faculty, both formally (meetings, work assignments) and informally (brainstorming, coffee/lunch). My best work comes from collaborating with others; conversations add context and meaning to the learning" [3D printing]. Runners in Lane A seemed inclined to involve others when those interactions led to their goal.

Runners in Lane A perceived affordances that furthered them in their task. Those in Lane A viewed learning tools, including ICTs, as opportunities to use the "correct methods" during learning [solving a 3x3 Rubik's cube]. Participants were more interested in "mak[ing] sure I was doing the steps right" [how to find standard deviation], and so made use of tools that provided this. This was often the result of resources that were plentiful or of quality and that met some personalized need (i.e., visual). Learners wanted something to *follow* because then they would not (or could not) be led astray. These learners kept with their collection of confirming cues and utilized tools that fulfilled some corrective purpose.

Table 6

Involvement with Others Summary

	with No One		with Coach		with Team		with Fans	
	N	%	N	%	N	%	N	%
Runner A (*N* = 39, 25.32%)	4	10.26%	15	38.46%	9	23.08%	11	28.21%
Runner B (*N* = 50, 32.47%)	8	16.00%	16	32.00%	14	28.00%	9	18.00%
Runner C (*N* = 25, 16.23%)	7	28.00%	4	16.00%	8	32.00%	6	24.00%
Runner D (*N* = 40, 25.97%)	7	17.50%	9	25.50%	14	35.00%	10	25.00%
Totals N = 151	26	17.22%	44	29.14%	45	29.80%	36	23.84%

Lane B

Runners in Lane B (*N* = 50, 32.47%) showed autonomy by proceeding linearly and implementing processes they most resemble formal strategies. The track metaphor is helpful: if self-teaching is metaphorically 'getting on the track', then runners in Lane B proceed to a 'starting line' and take a more *traditional lap*. In doing so, these runners view the track as a track, and as such, *run* it as a track. Runners in Lane B exercised autonomy by mirroring formal structures and processes. One participant explains how he taught himself coding:

> I started by looking at YouTube videos of the subject. Then I got some well-reviewed textbooks on the subject. I read through the textbook and attempted the practice problems. Once I got the basics down, I found a website called Project Euler, which are math problems that can be implemented in code. I did some problems on that site to test my proficiency and to see if I could solve other problems related to computer science.

Several notable differences can be made between this runner and one from Lane A. Probably the most significant shift is this runner's desire to learn coding *skills*, rather than just learning enough to complete a specific coding task. To do this, he *establishes structure*, *rehearses* using

practice problems, and self-*scaffolds* by removing supports when advancing to Project Euler. Further, like runners in Lane A, runners in Lane B gather predominantly confirming competence cues; this participant, by linking competence to the correct answers, found *proof* of learning. However, runners in Lane B may begin to gather affirming cues as perceived competence increases. Further, learners in Lane B utilized tools that most matched traditional learning strategies or that allowed them to target specific skills rather than the content, broadly.

Runners in Lane B were *establishing structure* to help them to move from start to end. While runners in other lanes used "structure", runners in Lane B showed autonomy in their purposeful and linear employment of learning strategies. Establishing structure became a necessary first step in self-teaching: "I define the problems, then look for the solutions. Then select one of the ways which serve my purpose as well as which comply with my background/ strength" [drawing using software tool]. When asked how he does this, he explained, "the information is all over the internet. But the information is not structured as per your requirement/understanding. So I try to structure the material according to my brain function" [cooking & drawing]. The vastness of information available prompted learners to understand the basics before diving in too deep. Establishing structure was a necessary step for a participant learning seashell diversity and identification: "how many types of seashells I wanted to know, how deep should I go?" To help with this, he "shared examples of different shells on my snapchat story, almost like an informal PowerPoint." Though structures are unique to learners, in Lane B, establishing structure was a deliberate process.

Runners in Lane B chunked learning content into bite-sized and manageable pieces. To illustrate, a participant "started learning guitar by watching YouTube videos and constantly practicing on my instrument." She explained that, first, she "learned the basics of guitar through

YouTube, chord diagrams, and constant practice." She set "little goals, like being able to switch cleanly from Am to C, or to being able to finally hold an F barre chord and get sound to come out of it;" these smaller *chunks* contributed to her broader goal of learning guitar. By chunking, runners in Lane B could focus on one step at a time; multiple participants reiterated this, such as one learning to breakdance, one learning to box, one learning to knit, etc. Chunking allowed learners to use structures to break learning down into manageable pieces.

Runners in Lane B used self-scaffolding during learning. In formal classrooms, instructors scaffold when they decrease learner supports while increasing rigor. Participants in this study demonstrated self-scaffolding when they behaved similarly by decreasing supports and increasing rigor. One participant who learned to play the ukulele exemplified this:

> I went onto websites that have the chords in relation to songs and taught myself the individual chords by looking at the diagrams and playing along to the song slowly. As I became more and more comfortable with the finger placement, I began to incorporate different strumming patterns. […] I would hide the diagrams for the chords to see how many of them I remembered.

This participant independently decreased supports (i.e., chord diagrams) while she increased the rigor (i.e., incorporate additional strumming patterns). Runners in Lane B used scaffolding to build skills over time. A participant captured this when learning to knit by starting "on a very simple scarf. Last spring while in quarantine I would just start increasingly complex projects forcing myself to learn new stitches and techniques." Given the self-directed nature of these projects, learners identified their own standards of rigor; but, and to contrast with Lane A, learners in this lane sought a larger skill than just a completed task. For instance, a participant who wanted to learn to use power tools to build household furniture explained,

> I received (gift) and bought power tools to build what I needed. I was tired of borrowing the neighbors for small projects, and when I decided to design bigger project [sic], it seemed I'd need my own tools. Second, I found the design for the project. Using the internet, I searched for something I might like and be able to build myself vs purchasing. Then, I practiced. […] My learning isn't complete. I've continued to make/design more complex projects and use practice and trial and error to get better.

For this participant, learning was not task-specific; she gradually increased the rigor of the task while decreasing the supports.

Runners in Lane B utilized rehearsal as a teaching method. Again, this does not imply learners in other lanes did not rehearse, but rather that, for runners in Lane B, rehearsal played a significant role in learning. Participants highlighted the combination of learning processes employed during learning; learners did not use only chunking or only self-scaffolding or only rehearsal, but a mixture: "I began by teaching myself how to read music, then I taught myself how to read the keys. I combined the two and just practiced continually until it became easier for me" [piano]. Rehearsal, as this learner used it, equaled practice; this method necessitated repetitive work on the road to skill mastery. For this reason, rehearsal was often linked with learners confirming competence cues: "I started by reading the manual. Next, I practiced performing some tasks. Finally, I cropped and toned a thousand photos. I felt competent after that" [using Photoshop].

Much like runners in Lane A, runners in Lane B gathered confirming competence cues. Many determined their success based on proof, external comparisons, or other confirming cues. For some, success was *very* obvious: "By 4 successful neuterings [sic] with very happy kittens" [neutering a cat]. These obvious signs of learning prompted runners in Lane B to proceed. But,

and unlike runners in Lane A, Lane B runners wanted to develop the skill and were not just seeking task completion. In some cases, as learners took multiple laps and gained the relevant skills, they shifted from gathering confirming to affirming competence cues. To illustrate, one runner collected confirming competence cues by making external comparisons of finished products, but when asked how she knew she had learned, used an internal metric: "I'm even working on a decently complex sweater" [knitting]. A second participant offered a similar account: she set a large goal (i.e., learn to crochet) and, through external comparisons, assessed early competence; however, when asked about her overall learning, this runner explained, "I am able to see a pattern or item online (mostly Pinterest) and replicate it. Simple items (like blankets, scarves, headbands, leg warmers) I can do based on sight and with a pattern I can do more complex designs" [crochet]. While she started by collecting confirming competence cues, after multiple learning episodes, this runner based her assessment on her developed confidence.

Runners in Lane B involved others who could provide more than just emotional support. Of the runners in Lane C, 16 (32%) involved a *coach,* 14 involved their *team,* and nine (18%) involved *fans;* only eight (16%) chose to learn in isolation (see Table 6 for summary). Runners in Lane B held clear goals and involved others who could help them reach those goals, explaining why several involved others who shared a language and could provide guidance. One participant explained, "I found this YouTuber who does RNG [random number generator] a lot and is good at it. I joined his discord sever and asked questions there" [using a computer program to manipulate a game]. A second Lane B runner transitioned from involving a coach to involving a member of her team:

> I had initial teaching from a friend/mentor that taught me some basic skills in saddling and bridling a horse. She was very supportive of me training my horse and provided

> facilities and tools to train my horse, though left me to my own devices on how to use that. She asked about what I was doing and celebrated with me when things went well. After my horse was basically trained, she took me out to a trail where we were able to really work on finalizing our training. [how to train a horse]

For runners in Lane B, the increased time spent engaged in learning allowed them to rely less on others and more on themselves.

Learners in Lane B showed a tendency for learning tools that most resembled the real thing or that maintained their need for structure. What this meant varied, but a driving force was creating an environment that was more formal learning. In some cases, this was akin to finding the "right teacher" who could "teach me the chords" [ukulele]; to do this, learners used videos, interpersonal interactions, or social media. In other instances, learners utilized learning tools and perceived affordances that reinforced their need for structure: "Having a YouTube video to walk you through something is so helpful, but when just reviewing I go to the blog. A blog post can be skimmed and are [sic] quicker. Pattern notes can be helpful for really specific techniques" [how to knit]. Even here, some learning tools provided access to new knowledge while others supported what was already known. Learners in this lane described some tools as huge, especially if they "allowed me to go back over things I wasn't sure about and see how all the different parts came together" [how to play a game]. The perceived opportunities of various learning tools often stemmed from the potential to simulate a formal learning space.

Lane C

Runners in Lane C demonstrated autonomy by not remaining bound to the track; many allowed themselves to take 'side-quests' during learning. Interestingly, few participants (N = 25, 16.23%) approached learning from Lane C. Runners in this lane are best described as *chasers:*

they start on the track along with other runners but, during the 'race,' may veer off course and 'chase down leads.' Learning is often a series of questions and answers; as such, runners in this lane are not concerned with reaching a traditional finish line. One participant was eager to learn about the diseases afflicting her family members:

> First, I had to narrow it down to one question about the topic that I could google. For example: my grandmother has Multiple Sclerosis, or MS. My first question was what is MS? I start by googling that and reading a reliable source. Then I just kept reading about it and learning. So I guess all I did was some reading and googling. […] If I came across a word or phrase I didn't understand, I opened another [tab] and looked up the definition. […] I could tell I was making progress because I was answering my initial questions and thinking of more. And I was learning things I didn't even think to ask. Benchmarks? None? I was just curious about a disease my grandmother has.

This leaner demonstrates the autonomy exerted by a Lane C runner: she started with a goal (e.g., learning about family members' illnesses) and then *chased down* information as it became relevant. Along the way, she gathered affirming competence cues by deciding she knew enough to quell her curiosity. Learners utilized tools that provided opportunities to further the chase.

Learners in this group did not start learning with a plan as much as they did with a broad goal and propensity to Google. One participant building a PC offered a clear example of this:

> All you really have to do is buy the parts, and assemble it like a Lego set. The trick and art to it is figuring out which parts to buy. Once I figured out what all the components were, I spent time researching and understanding how to select each individual part.

In the process of building a computer, this participant explained, "if YouTube suggests another source, I'll check that out too." A second participant who learned coding in HTML, CSS,

JavaScript, C#, RobotC, Vex, and some Python, explained this as "lots of research. Ask basic level questions, and realize that the answers are super complex. Take all the little pieces, figure out the basics of each, and start researching the more complex parts once you have a foundation." However, distinctly from runners in Lane B, learners in Lan C did not set benchmarks; instead, this learner chased down important information when and if needed, not before.

Runners in Lane C learned without parameters (see, Runners in Lanes A or B); many Lane C runners forged an entirely new path or left the *track* entirely. Participants described this using various metaphors: going on *side-quests*, *chasing* an answer, or going down the *rabbit hole*. A participant who learned to sew aptly detailed this approach: "I did research on the internet, starting with my goal and going down various 'rabbit holes' of sub-skills until I felt I had a general knowledge of what to do next." This paralleled a learner of select concepts from Quantum Physics, Human Biology, and Economics, who started broadly and "branched off to more specific cited articles, essays, books within introductory texts for my areas of interest." In both cases, participants started broadly and zeroed in on various other areas of interest as they went, an example of rabbit-holing.

Because runners in Lane C did not have concrete plans, they could not establish benchmarks (e.g., "Specific benchmarks, I didn't really have any; I just wanted to learn how to code" [coding]); confirming competence cues did not appear as important to runners in this lane. As explained by this participant, "explor[ing] the environment on my own was a significant help. Although I did seek out answers online case by case, the comfort and confidence in my abilities came from trying things out, undoing them, and learning from the mistakes" [Windows Systems Administration]. Runners in Lane C affirmed their learning by increasing in confidence. There

was not a correct, verifiable answer; and for many, there was no need for one. A participant self-teaching Reformation Theology explained, “I started by reading introductory books and speaking with local experts. After that I dove into deeper material and picked up listening to podcasts. I have not completed my learning, and don’t think I ever will.” High levels of autonomy and preference for affirming competence cues allowed runners from Lane C to learn about a topic for as long as they wanted.

Runners in Lane C involved others who served as a potential node in their growing network. Seven runners (28%) in this lane chose to learn in isolation; of the remaining participants, eight (32%) involved their *team*, six (24%) involved *fans*, and four (16%) involved a *coach* (see Table 6 for summary). Runners in this lane recognized the worth of learning with others with experience. One participant learning to conduct a tax lien sale worked with a woman who had experience: “She was nice, telling me what she prepared for the sale, what website she used, and how the process worked. I got some useful info from her. […] This gives me a start point for doing my own research.” This participant made clear the woman, the website, and other consulted resources added to her collective knowledge. These interactions with others were valuable not because they offered an answer but because they offered encouragement. As one participant explained, in making an Amish toothbrush rug, she would send her family “photos throughout the progress to show them what I was doing.” She added, these interactions were “not terribly important to the learning process, but they were helpful in motivating me to keep going.” Her family members were only one node in a larger network.

Learners in Lane C utilized tools that provided opportunities to conduct these chases. For instance, one learner utilized Pinterest because the options were endless, which meant she could explore as long as she wanted: “Pinterest held recipes, a lot of which held comments with

‘tweaks’ to the recipes” [baking]. Interestingly, and in contrast, this learner was unable to learn other learning topics using the same tendency: “there are so many ins and outs of embroidery that make it difficult to teach myself. I need someone to show me how to begin.” For some learners, the result of a learning episode was determined by how deeply the content was explored. At times, what the learner intended to learn was exceeded. For instance, one learner explained,

> Videos that show the systematic elements of the knowledge I was seeking- like color theory and setting times for hair dye, placement of different lengths of hair, and breaking down the fret system and scales for guitar, a video titled ‘chord progressions of 50 popular songs-- they're all the same’ showed me that the essence of the skill is based on a core of intuitive scales, present in everything from the vibrations of crystals, boiling water, and color itself. Youtube is very useful. [dye hair & play guitar]

This learner sought information regarding hair dye and, after engaging in the rabbit hole, discovered knowledge regarding color theory. This was not a part of the plan, but not having a plan meant learners had free reign.

Lane D

Lane D runners (N = 40, 25.97%) demonstrated their autonomy through innovation. The track metaphor illustrates this: runners in lane D approached learning *backwards* by starting with the application, experimentation, and trial-and-error. For example,

> I work at a thrift store and a wood burning tool came along. I was looking for new hobbies and enjoy working with hands and creating something physical. The kit came with a couple pieces of wood, so I used the back of them to see what happened when I used a certain tip or applied different amounts of pressure. When I felt comfortable, I

could use it semi properly, I drew an easier sketch of initials and leaf vines so I could practice my lines and experiment with shading. I realized I could do different shades while practicing on the back. It is not complete. There is always more to learn. But I did begin to watch clips of YouTube videos after my first two projects. [wood burning]

As this participant depicts, runners in Lane D do not plan their learning, and may come to it on accident. When learning, runners in Lane D tinker, play, or mess around with [X]; as one participant explained, I "tried, undid, redid, started over, and tried again" [piano, cake decorating, drawing, painting, calligraphy], a process another aptly labeled and described as *destructive disassembly*: "This is especially great for unknown objects that are easy to damage. Many times have I taken something apart just to see how it works" [rebuilding complex components of car engines]. Like Lane C, runners in Lane D gather affirming competence cues throughout learning; however, in Lane D, runners may make their final assessment using confirming cues. When utilizing learning tools and perceiving affordances from these tools, learners in Lane D sought inspiration rather than instruction; various tools allowed for this tendency.

Autonomy for Lane D runners manifested as a backwards route. Runners in this lane *start by doing*, as demonstrated by a participant self-teaching how to play disc golf competitively; in this case, the runner "started with kinesthetic learning (learning by doing) and the empirical process (experimenting and noting successes and failures). I then consulted a variety of written and visual media…" Several participants explained their processes as having a more unorthodox approach, where their learning methods may not be deemed correct by others. As one participant noted, "I started by looking up on the internet 'how to play guitar.' This was a failing tactic because I got bored and did not see the value in what I was learning" [guitar]. This learner

decided, rather than learn the basics and build, she would learn one specific song (e.g., "Apologize" by OneRepublic). She explained the failing tactic a bit further:

> I tried to learn beginner songs and approached it in the route a typical person would take. I got bored of the easy songs and skipping ahead in the book felt too hard. Because of this, I did not enjoy learning and ended up giving up.

More formal methods would not have helped this learner make progress because as she explained, "I could never learn something I do not want to learn." Runners in Lane D, by starting with the end, ensured the experience was *valuable* while keeping it fun.

Though runners in Lane D have a goal, they are willing to deviate from that goal if necessary. Lane D runners explain their challenges are simply opportunities for innovation, not defeat. One participant explained their innovative approach to making weighted blankets:

> The blankets are very cumbersome to make on my sewing machine to assure the pellets stayed in place while I was sewing. I came up with an idea to use plexiglass strips with clamps to put on the portion of the blanket I am working on that holds the pellets but is still flexible.

The innovative solution to this learner's problem resulted in a different approach to learning, a process many learners referred to as *trial and error*. One participant offered a summary of this approach: "The biggest challenge I faced would be correct tension when threading the machine for certain fabrics. Most of this was trial and error, testing and seeing what worked or didn't" [using a sewing machine]. An increased acceptance of innovation brought with an increased *acceptance of failure*. Learners "tried, failed, tried, got frustrated, failed again and again, and then finally successfully knit several rows" [knitting]. This learner added, "I allowed myself time to get frustrated and walk away. I think that's an important part of learning – to leave and

return." As one participant stated, at times it may be necessary to figuratively and literally *seam-rip:* "Sometimes if I just didn't understand something I would proceed with what I thought was correct, only to be wrong. Everything I had done would have to be 'seam ripped' and I would have to start over" [sewing]. Runners in Lane D highlighted their use of innovation and trial and error as manifestations of their control.

Like Lane C, runners in Lane D gathered affirming competence cues by conducting internal comparisons, building confidence, and developing muscle memory; however, and to differentiate from Lane C, some runners in Lane D sought confirming cues at the end of learning to determine success. For example, a participant who self-taught Jazz Piano explained mixing affirming experiences with confirming experiences: "I think there is some danger in being too rigid with goals as well. I think it's okay to have periods where you are more regimented and periods where you are more loose [sic]." The more regimented experience, for this learner, was being evaluated by outside others (e.g., public performance for a live audience; *fans*) while the loose experience was *jamming* with friends (i.e., his *team*). As such, this learner combined confirming and affirming competence cues to determine success. Runners in Lane D may end their lap by either confirming or affirming learning. To compare, a participant learning photography and watercolor painting explained using external comparisons during learning but based her learning determination on how "proud of the work I have done, and I think that I have definitely evolved." Conversely, a participant who learned to fix jet skis assessed competence on both confidence and proof of learning; this learner started by taking the jet skis apart and grew in confidence, but in the end, the jet skis needed to work (i.e., proof) for the learner to be successful.

Runners in Lane D involved others to build or strengthen a community. Few runners in Lane D (N = 7, 17.5%) learned with no one else; of the remaining, 14 (35%) learned with a *team*, 10 (25%) learned with *fans*, and nine (25.5%) learned with a *coach*. (See Table 6 for a summary.) Runners in this lane prioritized the development of a learning community. As one lamented, at his university, other students and faculty did not share his interests, but he did "interact with a number of people through online homelab forums and IRC [internet relay chat] channels. They helped me through more than one issue that would have otherwise been showstoppers, because they themselves had experience" [Web hosting with a personal webserver]. Participants in Lane D valued others with shared experiences and were eager to use digital channels to broaden their circle: "Through my Instagram I was able to befriend global artists and share about our affective experience, but not necessarily techniques. Just knowing other people were spending hours with eye strain from the iPad was super helpful" [digitally sketch contour illustrations]. For these runners, building a community aligned with their learning goals. For some participants, to show mastery of a skill was to be admitted into a community. One participant, whose native language is Spanish, lost her fluency and skills over time; as she explained, "when I call my dad, I insist on speaking Spanish unless if we need to discuss important matters in which I still lack the necessary vocabulary" [relearning native language, Spanish]. She wanted to be in a certain community (i.e., Spanish speakers), so she involves others who could help her achieve that.

Learners in Lane D utilized learning tools that supported their innovation and that provided inspiration rather than instruction. For instance, a learner of guitar described YouTube as allowing her "to learn any skill that I needed" while a second learner compared baking macarons (successfully) to learning guitar:

> I tried to teach myself guitar and used this app. I was too focused on perfecting the "game" to pass rather than play. You had to pass to continue on so I never really kept going. Macarons is more of a song where you play through and perfect as you keep playing it where the guitar was perfecting notes before completing a song.

Incidentally, what worked for one participant to learn guitar was a failing tactic for another; the difference was the inspiration to continue learning.

Post Hoc Analysis

Each *lane* represents an approach to SDL; runners within a lane show a tendency toward that approach. This left me with four groups of runners to compare. I collected data on participants' levels of state motivation, metacognitive awareness, and affect toward content. All variables were converted to z scores. Initial analysis included Pearson's correlation (see Table 7) and ANOVA (see Table 8).

Table 7

Correlation Matrix for Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Learning Success							
(2) Motivation	.03						
(3) Planning	.06	.19*					
(4) Information Management Strategies	-.03	.24**	.42**				
(5) Comprehension Strategies	-.08	.20*	.65**	.51**			
(6) Evaluation	-.17*	.22**	.64**	.44**	.77**		
(7) Affect toward Content	.01	.42**	.17*	.07	.26**	.26**	

Note. *$p < .05$ **$p < .01$

There were significant relationships between lanes of learning and two of the dependent variables—namely, State Motivation, $F(3, 149) = 3.93$, $p = .010$, $\eta^2 = .06$, and Planning (Metacognitive Awareness), $F(3, 149) = 3.11$, $p = .028$, $\eta^2 = .06$. As shown using Duncan's Post hoc analysis (Table 9), runners in Lane A reported significantly less state motivation ($M = 5.64$,

SD = .85) than runners in the other three groups. Runners in Lanes C and D differed significantly from Runners in Lanes A and B on planning. (Mean plots for both variables are provided in Appendix I.)

Table 8

Between-Subjects ANOVAs

Source	*Df*	*SS*	*MS*	*F*	*p*
Success					
Factor	3	1.32	0.44	0.26	.853
Error	149	250.03	1.68	-	-
State Motivation					
Factor	3	6.44	2.15	3.93	.010*
Error	149	81.38	.55	-	-
Affect Toward Content					
Factor	3	0.32	0.11	0.25	.864
Error	149	65.42	.44	-	-
Metacognitive Awareness: Planning					
Factor	3	5.34	1.78	3.11	.028*
Error	149	85.32	.57	-	-
Metacognitive Awareness: Information Management					
Factor	3	0.80	0.27	0.90	.445
Error	149	44.27	.30	-	-
Metacognitive Awareness: Comprehension Management					
Factor	3	3.12	1.04	2.28	.082
Error	149	67.95	.46	-	-
Metacognitive Awareness: Evaluation					
Factor	3	3.31	1.10	1.58	.196
Error	149	104.02	.70	-	-

Note. The dependent variable for each ANOVA is specified in the table spanner above each set of results. The lanes of learning tendency categories (four groups) served as the factor in all ANOVAs.
* $p < .05$

Section Summary

In this section, I presented a *Lanes of Learning* model of SDL. Based on the evidence, self-directed learners satisfy their needs for autonomy, competence, and relatedness in varied ways depending on their learning goal. Four *lanes* emerged and were explored in this section; a brief recap, with examples, is provided in Table 10.

Table 9

Post-hoc Analysis of Significant Variables

	State Motivation		Planning	
	M	*SD*	*M*	*SD*
Runner A	5.64[a]	.85	3.73[a]	.73
Runner B	6.01[b]	.69	3.72[a]	.83
Runner C	6.05[b]	.76	3.31[b]	.78
Runner D	6.09[b]	.66	3.41[ab]	.68

Note. Means with no subscript in common differ at $p < .05$ using *Duncan's* post hoc comparison.

Table 10

Lanes of Learning and Examples

Codes & Subcodes	Examples
Control Approach Type	
Runner A (*N* = 39, 25.32%)	"I start by either reading or watching a video, videos are a lot easier to understand and stay focused. After that I try it myself and that's basically all I do. I usually only teach myself to complete something so I might complete an assignment or a test."
Runner B (*N* = 50, 32.47%)	"I started by looking at YouTube videos of the subject. Then I got some well-reviewed textbooks on the subject. I read through the textbook and attempted the practice problems. Once I got the basics down, I found a website called Project Euler, which are math problems that can be implemented in code. I did some problems on that site to test my proficiency and to see if I could solve other problems related to computer science."
Runner C (*N* = 25, 16.23%)	"First, I had to narrow it down to one question about the topic that I could google. For example: my grandmother has Multiple Sclerosis, or MS. My first question was what is MS? I start by googling that and reading a reliable source. Then I just kept reading about it and learning. So I guess all I did was some reading and googling. […] If I came across a word or phrase I didn't understand, I opened another [tab] and looked up the definition. […] I could tell I was making progress because I was answering my initial questions and thinking of more. And I was learning things I didn't even think to ask. Benchmarks? None? I was just curious about a disease my grandmother has."
Runner D (*N* = 40, 25.97%)	"I work at a thrift store and a wood burning tool came along. I was looking for new hobbies and enjoy working with hands and creating something physical. The kit came with a couple pieces of wood, so I used the back of them to see what happened when I used a certain tip or applied different amounts of pressure. When I felt comfortable, I could use it semi properly, I drew an easier sketch of initials and leaf vines so I could practice my lines and experiment with shading. I realized I could do different shades while practicing on the back. It is not complete. There is always more to learn. But I did begin to watch clips of YouTube videos after my first two projects."

CHAPTER 5: DISCUSSION

The goal of this dissertation was to explore how self-directed learners assess their learning in informal contexts. Employing multiple methods better illuminated the conditions which allowed for learners to feel successful in SDL. Analysis focused on self-directed *learners* (i.e., motivation), self-directed *learning* (i.e., actions), and the impact of perceived affordances of various learning tools. Based on the evidence, I argued for a *Lanes of Learning* model of SDL. Models are useful heuristics by which we make sense of the world (Shoemaker et al., 2004); this model shows how learners control learning processes, assess competence, and involve others during self-teaching (Figure 5). The track-and-field metaphor provides a useful language through which we can dissect these findings.

In what follows, I answer each of the posed research questions. I focus this discussion on how participants satisfy their basic needs, self-regulate, and perceive affordances. Next, I articulate this study's primary findings as well as what this adds to the field of instructional communication. After, I link these findings to current formal learning strategies (e.g., Differentiated Instruction; Crossover Learning) in ways that can help classroom instructors implement opportunities for SDL. Last, I offer limitations and potential paths for future research.

Self-Directed Learners: Satisfying Basic Needs

To study SDL is to simultaneously study *learners* (i.e., motivations) and *learning* (i.e., processes) (Hiemstra, 1994). This distinction cannot be ignored. Learners' motivations do not automatically equate with significant learning processes (see Kim et al., 2017). Deci and Ryan (1987) offered a framework to explain increased intrinsic motivation and argued satisfying needs for autonomy, competence, and relatedness help learners to feel motivated. In this dissertation, I explored informal learners' motivations by answering the following question: How do self-

directed learners in informal contexts satisfy their need for a) autonomy, b) relatedness, c) competence, and d) prioritize the satisfaction of these needs? To remain consistent with the presentation of results, I first discuss how learners satisfy their basic needs for competence, relatedness, and autonomy, which includes brief discussion of the *Lanes of Learning* model, and how learners in each lane prioritize their basic needs.

Competence

Evidence shows learners satisfy their need for competence by collecting either *confirming* or *affirming* competence cues while learning. Confirming competence cues included identifying immediate or visible progress, comparing (externally), and seeing proof of learning; affirming cues included increasing confidence, comparing (internally), and developing muscle memory. The distinctions between these cue types warrant discussion. If learners fulfill a need for competence by achieving positive outcomes against optimal challenge (Cerasoli et al., 2016), it is unsurprising that many participants sought *confirmation*. Receiving correction or feedback was, at times, crucial for participants in this study (see Ellis, 2000) but was not universally valued. To contrast, learners gathered *affirming* cues that were more personal but less concrete; several noted these cues were less about correctness and more trusting their knowledge.

The distinction between confirmation and affirmation is easily summarized: some learners had to *know* they learned (i.e., confirmed) while others were okay *feeling* like they had learned (i.e., affirmed). The sequence of these cues shifted depending on the lane. Runners in Lanes A or B prioritized confirming cues (not that affirming cues were nonexistent, but they were identified to a lesser extent) while runners in Lanes C and D focused on affirming cues. Learners did not always have confidence in their future abilities, and more so, did not always show concern for that (a focus on motivation); additionally, learners expressed not needing to

find the correct answer but to know the logic was right (a focus on process). This speaks to a larger consideration: perhaps the difference is between successful *learning* and a successful *learner,* in that learners can see their processes as correct but lack motivation, or vice versa, feel motivated but see the processes as deficient.

While runners in Lanes A and C gathered exclusively confirming and affirming cues, respectively, runners in Lanes B and D demonstrated shifts in preference. In Lane B, runners approach learning in segments and, at the end of each, assess competence by gathering confirming cues, which indicate and determine whether they can move on. Eventually, given the increased investment of resources (e.g., time, money), runners start to rely less on external cues and more on internal (i.e., a shift from confirming cues to affirming cues). Runners in Lane B might eventually internalize their learning, much as they might in formal spaces (Deci & Ryan, 1987, 2000), and continue to run extra *laps* to perfect skills. This was not uniform for all runners in Lane B, but the pattern was salient enough that ignoring it was not plausible. To contrast, Lane D runners learn by innovating and are understandably led by affirming competence cues. But by the end, some runners in Lane D split away and seek a confirming end. For example, a learner who self-taught jet ski repair indicated still needing to confirm the jet skis worked after being led by what *felt* right (i.e., affirming cues).

A caveat must be raised in response to these findings. Learners in informal contexts set their own parameters, so failure may not be possible. Of course, this is dependent on lane tendency. Learners in Lane A, because the learning is contingent on the task, are prone to view their *learning* as either successful or not; others, especially those in Lanes C and D, expressed that learning did not end. This conflicts with formal learning spaces where credentials and sequences of curriculum may prevent learners from allowing themselves to *feel* rather than *prove*

success. Lane C learners may *leave* the track entirely, but fewer learners tended for this lane than others. Perhaps, even in informal environments, learners recognize the risks of trying something unknown and shy away from spontaneity as a result.

Relatedness

Participants in this study involved others for both functional (i.e., coach) and emotional reasons; when their reasons were emotional, participants distinguished between those who did share a language (i.e., team) and did not share a language (i.e., fans). Learning is social, including learning in informal spaces (Watkins et al., 2018), and so it was not a surprise that, of the 154 participants, 128 (83.12%) involved others in their learning, leaving only 26 (16.88%) who learned in isolation. Of those who included others in their learning, few (N = 26, 20.31%) reported the experience was unimportant. Evidence suggests participants satisfied their need for relatedness – being seen, valued, respected, or desired by others (Cerasoli et al., 2016), but variation exists in how this is done and with whom.

Runners in Lanes A and B involved others who could provide precise feedback while runners in Lanes C and D involved others who helped them stay emotionally invested. Regarding feedback, learners in all four lanes were open to feedback from coaches, but the degree to which they adopted that feedback varied. As found by Cerasoli et al. (2016), informal learners need to be in control of their feedback and the feedback must be from a trusted source. Participants in this study demonstrated a similar drive: feedback came from experienced and trusted sources with whom the participant shared a language.

In contrast to those in Lanes A and B, runners in Lanes C and D involved others to build a network or receive emotional support. Unsurprising, runners in Lane C did not want specific instruction; that was not their tendency. To give up control over their learning to someone else

contradicted their desires for autonomy. However, for runners engaged in rabbit-hole learning, each new person is a unique node on their growing network (Downes, 2008; Siemens, 2006). Sharing their findings with others and receiving positive encouragement was helpful but inconsequential to overall learning. Runners in Lane D worked to build a larger community. At times, involving others with similar experiences (i.e., team) trumped involving others with the correct answer (i.e., a coach). Lane D runners innovate and embrace out-of-the-box thinking, allowing them to move through multiple iterations of the same problem. Technology expedited this process: learners could use digital technologies to hang out, mess around, and geek out – a cycle of informal learning where they observe, tinker, and build from technologically-enhanced tools (Collins & Halverson, 2018).

Several participants used technologies to involve others in their learning. Much of what participants reported on occurred during the COVID-19 pandemic when face-to-face interactions were not possible or limited. Phone calls, video chats, texting, and other means digital communication allowed participants to connect with others (Bonk & Lee, 2017; Song & Lee, 2014). Importantly, participants did not require synchronous communication with others to learn with them. Many reported *lurking* on discussion forums or Discord servers, never interacting but noting the interactions were important. Perhaps self-directed learners do not need reciprocal or contingent communication with learning others (Walther, 2019) but feel community from joining the group.

The LOL model does not situate runners as competitors, but the nature of this metaphor invites this speculation. This may also be an artifact of more traditional learning patterns where, for one learner to do well, others can not (e.g., Law school, Medical school). With this model, I am not arguing learners compete with one another; rather, many of those involved engaged from

the sidelines or the stands. Further, not all learners who involved others acted on those teachings or collaborations. More research can be done to parse out which interactions contribute to *learning* and which did not contribute to learning.

Autonomy

Participants satisfied their need for autonomy by maintaining control of learning from start to end – even when that *control* was a lack of control (e.g., Lane C). Self-directed learners serve as the author, investor, and director in their learning (Weinstein et al., 2012), and more importantly, determine when and where to engage in learning (Ahearn, 2001; Reeve & Tseng, 2011). Participants in this study felt *in control*, and this control manifested – both in terms of desire and action – as four tendencies for learning, depicted as a *Lanes of Learning* model. Not all participants desired the same kind of autonomy; the spectrum ranged from *task-completion* to *trial-and-error* and from *fully structured* and to *rabbit-holing* – all representative of distinct levels of autonomy. This evidence reinforces past findings that some learners have a very clear path and outcome in mind while others just want to surf the internet (Cabrero & Román, 2018). Not all learning is purpose driven.

Control manifested differently for learners, but all maintained the characteristics of self-directed learning. Within SDL literature, scholars posit three factors contribute to successful regulation: the learner 1) experiences freedom/choice, 2) has control, and 3) is interested in the learning (see Song & Bonk, 2016). Runners in each lane experience choice, control, and interest, but again, what these feelings prompt varies. For example, Lane A runners explained choosing to learn only what was necessary while Lane C runners established no boundaries; Lane B runners deflect some control to the structures they develop, and Lane D runners select topics of high interest. All tendencies fueled future actions.

Further, the level of control a learner has may dictate whether an *end* exists at all (e.g., Lane C). One learner broke learning into 12 steps while another explained their process as "some reading and some googling." Both learners possessed autonomy, but this manifested as different levels of control. What became interesting was the number of learners who precise endings versus learners (N = 33) who described learning as *incomplete*, reinforcing a need to study autonomy among adult learners more closely. Importantly, of the four lanes, participants took Lane B most frequently, so even in informal contexts, learners do value structure and provide their own if needed.

Prioritization of Needs

Participants in this study made clear their decisions helped satisfy needs for competence, relatedness, and autonomy. Learners in each lane satisfied their learning needs in their tendencies toward specific lanes; each lane provides a heuristic for how self-directed learners may proceed. Self-directed learners determine what is important to them and then engage in processes to match those tendencies. For instance, a Lane A runner does not care about depth of learning (much like a Lane C runner would) and prefers instead to complete the task; a Lane C runner would be willing to veer off course while a Lane B runner would not. By acting on these tendencies, learners took control.

Learners prioritize different goals depending on which lane they prefer. In brief, runners in Lane A prioritize efficiency and fulfill short-term, task-related goals; runners in Lane B prioritize structure and formality; runners in Lane C prioritize spontaneity and chase down information as it becomes relevant; and runners in Lane D prioritize innovation and trial-and-error. These priorities fuel learning decisions, influence how learners move from start to end, and become exemplified in learners' self-regulation.

Self-Directed Learning: Self-Regulation

Evidence shows learners engage in self-regulation, but much as with learner motivation, what this regulation looks like varies by lane. Self-regulation labels the actions taken by learners to start, maintain, and assess learning, to evaluate learning outcomes, and to control learning processes (McCombs & Marzano, 1990; Panadero, 2017; Stubbé & Theunissen, 2008; Zimmerman & Pons, 1986; Zimmerman & Schunk, 2008; Zimmerman, 1990). Because Hiemstra (1994) argued self-direction is a combination of motivations and processes, and because the first research question focused on *learners* and motivation, this second RQ asked, "How do self-directed learners in informal contexts self-regulate their learning?"

Participants in this study, for the most part, initiated their learning and maintained control. Few exceptions included participants eventually acquiring a formal *coach*, which transferred control, or participants being prompted by some external force to start learning, taking away internal initiation. Future research should explore self-regulation and initiation from an Attribution Theory lens (Weiner, 1972); this project cannot determine whether initiation for each learner was internal or external, but evidence suggests distinctions may exist between learners who view an internal (vs. external) locus of control and whether the situation is stable (vs. unstable) and controllable (vs. uncontrollable).

In the Lanes of Learning model, I argue participants exercise control in various ways. Evidence clarifies that, even when learners do not appear structured, they are in control. It is important not to conflate control with *structure*. Learning, as a series of actions and reflections (Marsick et al., 2006), need not occur linearly. Based on the evidence, I argue SDL is both episodic – each moment may and can stand alone – as well as cyclical – each moment may build from and to the next. This seems contradictory, but when we explore evidence that technology

has shifted the boundaries of the knowledge monopoly (Jadlemark, 2018) and that learners have access to hundreds upon thousands of resources (Ryberg et al., 2012), linear learning no longer make sense. Add to this that learning was only designed to be linear in the interest of mass producing its outcomes (see Newfield, 2018) and it becomes increasingly clear why not all learners leapt at linear structures.

Participants demonstrate that not all self-regulated learning is relegated into three phases (i.e., forethought, performance, and assessment). This is perhaps contrary to what we know about self-regulation (Anthonysamy et al., 2020; Boekaerts & Minnaert, 1999; Nilson, 2013); however, because the context is informal, research about this regulation is limited. Thus, while some learners (e.g., Lane C) seem to forgo organization, others (e.g., Lane B) rely on it. Lanes A and D are even more unclear: in Lane A, the learner may choose to expedite the learning by skipping entire steps while in Lane D, the learner may choose to start with "Z" (as opposed to the more common "A"). Evidence indicates movement between or within phases is less restrictive than in formal environments. Runners seemed willing to completely scrap a project (i.e., assessment to performance transition) if something was not working; others engaged in evaluation before performance ever began.

SRL also accounts for positive learning outcomes. Results from the post hoc analysis lend support for the levels of learning that did occur. Participants in all lanes reported heightened levels of state motivation, affect toward content, learner-perceived success, and metacognitive awareness. Two key findings emerged from the post hoc analyses: first, learners in Lane A reported significantly lower state motivation compared to other runners (but, interestingly, did not differ in levels of affect toward content); second, learners in Lane C reported significantly lower *planning* compared to other runners. Although these findings do not provide causal

support for learners in Lane A being less motivated or for learners in Lane C being less planned, that these distinctions exist at all warrants further exploration of learning outcomes across the LOL. More sophisticated analysis and use of regression analysis may be able to determine if motivation or planning (or any myriad of variables) affect learner perceived success.

Perceived Affordances

The term *affordances* labels perceived possibilities for action offered from an environment, context, or tool. Past findings depict affordances as tied to user agency (Dings, 2020), which is of high importance in informal contexts (Ahearn, 2001). Given the increased attention on affordances in informal learning literature (Czerkawski, 2016), and the clear attention pilot participants placed on learning possibilities, I asked this RQ: "What affordances are perceived by informal learners during self-directed learning?"

Based on the findings, I posit learners utilize learning tools to aid their larger goals, and, importantly, the affordances perceived in SDL reflect learners' larger values. In short, an understanding of affordances perceived during self-directed learning – since not all affordances will be perceived by all users (Norman, 1999) – more clearly defines what matters to learners during self-teaching episodes. Three affordances were perceived by participants: *accessibility* (including *to fast material*, *to quantities of material*, and *to quality material*), *personalizability* (including pre-determined preferences for *visual* and other *individualized* resources), and *adaptability* (including *manipulating* or *mimicking* the resource).

Users valued learning tools that could provide access to fast, an unlimited supply of, or quality information. Evidence from this study supports past findings regarding users' habits when engaged in digital learning, including bouncing between resources (AlDahdouh, 2018), repeatedly learning, unlearning, and relearning because of this access (Utecht & Keller, 2019),

and engaging in micro-learning (Boileau, 2018). Further, more runners in each lane valued access above other possible opportunities (see Appendix J for summary), but to think that all participants access material in the same manner is naïve. Learners in Lanes A wanted a higher quantity of material while runners in Lanes C and D valued quality material over the quantity of material. As an affordance, *access* has been labeled by past scholars (for example, Boileau, 2018), so that participants valued tools providing access is less so surprising and more in line with how today's technologically connected learner learns.

Other participants valued the option to *personalize* the learning tool in some minor way, such as finding ways to individualize the tool or matching the tool to their learning preference (i.e., visual). This finding shines a positive light on personalized learning (see Waldeck, 2007). As has been argued, instructors who create personalized learning environments for students invest additional time and resources into those endeavors, at times to no avail. Not all students know how to personalize learning in formal contexts (Dabbagh & Kitsantas, 2012), and others may stop because as personal preferences are formalized; however, embracing personalizability can bridge the formal and informal contexts. Findings of the current project support the use of personalized learning and suggest users will personalize independently if given the chance.

Perceived *adaptability* identifies opportunities to manipulate a learning tool, most often through stopping, starting, pausing, etc. Users value tools that allowed them to choose how, when, and where they learned, which only reaffirms the finding that learners value control in these learning episodes. Importantly, participants manipulate multiple learning tools, including videos, social media, books, and web documents, in similar ways (e.g., customizing a Pinterest page to show top resources). Findings show learners in Lane B are more likely to manipulate a

resource than other runners; these runners establish structure, chunk, and self-scaffold, so maintaining control over the tool is a priority.

Evidence shows users perceived affordances based on what they needed and wanted in that moment, what was important to them, and what helped them meet their goal. The three affordances that emerged from this dataset paint today's learners as technologically connected. Learning tools, and ICTs specifically, are abundant (Harasim, 2017), so it should not be surprising that technologies played an increased role in these learning episodes. More generally, participants demonstrated their control over learning resources and valued tools, regardless of what the specific learning tool is, that wrought increased access, personalization, or adaptability, providing evidence to arguments that it is not the technology that matters but the affordance perceived from it (Czerkawski, 2016; Osborne & Dillon, 2007). Furthermore, analysis regarding affordances may have been impacted by an artifact of the method. Questions regarding perceived affordances prompted learners to select a tool that most aided their learning. However, throughout analysis, it became possible that the perceived affordances built upon one another. For instance, a tool of high *quality* (i.e., accessibility) could also be *visual* (i.e., personalizability). During analysis, I coded based on participants' larger experiences, which does not adequately capture how learners utilize multiple tools or perceive multiple affordances. More research should explore this.

Understanding *Lanes of Learning*

Understanding learners' motivations, processes, and perceived affordances in isolation is valuable and offers much we can leverage in formal spaces when introducing opportunities for SDL (see below) but doing so does not tell the full story. These elements do not exist in isolation. Learners perceive affordances while keeping themselves motivated while self-

regulating. Based on this line of thinking, I asked the following question: "What relationships exist between the satisfaction of learners' basic needs, self-regulation, and perceived affordances during self-directed, informal learning?"

In short, self-directed *learners* engaged in self-directed *learning* do not operate uniformly; rather, four primary patterns emerged to explain how individuals succeed in self-teaching. As theorized in the LOL model, runners in each lane satisfy their basic needs, self-regulate, and perceive affordances in unique ways and based on their larger goal(s). These patterns are reviewed below:

- **Lane A** runners prefer efficiency (autonomy), engage in task completion (regulation), collect confirming competence cues (competence), involve others for functional purposes (relatedness), and use tools provide a set of steps to follow (affordances);
- **Lane B** runners prefer structure (autonomy), engage in chunking, rehearsal, and self-scaffolding (regulation), collect confirming competence cues but may also collect affirming cues (competence), involve others for functional purposes but after extended commitment may also involve others for emotional purposes (relatedness), and utilize learning tools that most resemble a formal learning space (affordances);
- **Lane C** runners prefer depth of knowledge (autonomy), start with a broad question and chase down information as it becomes relevant (regulation), collect only affirming competence cues (competence), involve others to grow their network (relatedness), and utilize tools that provide more content to chase (affordances); and,
- **Lane D** runners prefer innovation (autonomy), engage in trial-and-error (regulation), collect affirming competence cues but also confirming cues at the end (competence),

involve others to build a community (relatedness), and use inspirational tools (affordances).

Collectively, the LOL model provides a useful framework of the many distinct and complex ways adult learners engage in SDL, specifically in informal contexts (Furlong & Davies, 2012). Because informal learning "accounts for the great bulk of any person's total lifetime learning-including that of even a highly "schooled" person" (Coombs & Ahmed, 1974, p. 8), and because ICTs allow access to diverse sources of information, "reinforcing rather than activating processes of self-education" (Selwyn et al., 2006, p. 156), developing a richer understanding of these contexts becomes crucial. This project meets that demand.

The LOL model is especially useful for individuals looking to increase opportunities for SDL (i.e., teachers) or for learners looking to understand their own tendencies. Participants exercised their control over learning through their selected processes, how they determined competence, who they involved, and what affordances they perceived. Learner control manifest differently based on learning tendencies. Evidence from the current study is consistent with past research that shows learners like to and can direct their own learning (Clough et al., 2008; Lai et al., 2013). Learning in informal spaces is predicated on interest, so individuals in this study wanting to maintain control over their learning fits current assumptions. Where this study differs, however, is that learners in informal contexts still satisfy the same basic needs they do in formal settings – but the degree to which these needs are met and how they influence learning strategies is distinct per the learner's *lane*. Though shifts have been made in formal contexts to increase learner empowerment/mastery (Downes, 2010; Frymier et al., 1996; Gikas & Grant, 2013), learner autonomy (Czerkawski, 2016; Gorard et al., 1999; Greenhow & Lewin, 2016; Tan, 2013), or learner choice in teacher (Lai et al., 2013), these contexts are definitionally restricted

by the credentials, rewards and/or punishments, and other external influencers. In informal contexts, autonomy is presumed, so studying autonomy in these contexts provides a clearer account of what is occurring. The current project continues to reinforce the need for learner freedom in formal spaces, though these findings also reveal the challenges in accomplishing this.

Current evidence supports the importance of internalizing content as relevant, even in informal contexts. Though most participants reported high levels of state motivation, a clear distinction existed between learners in Lane A and learners in Lanes B, C, and D. Learners in Lane A engage in SDL because they want (or need) to finish some underlying task; "learning" is an afterthought, aligning with what Merriam and Bierema (2014) call incidental learning or what Livingstone (1999) calls "just-in-time" learning. And because learners in Lane A want efficiency, they collect confirming cues. A learner completing a task is less concerned with future confidence (i.e., self-efficacy; Bandura, 1994, 1999) as the chances of them completing the same task again in the future are slim. It would not be necessary to feel highly motivated regarding the learning – but more so the task itself. However, these learners were not significantly different in affect toward content, indicating they still *valued* the learning. Learners in other lanes, however, selected topics that were important to their identities (Prinski et al., 2018), perhaps starting them with an advantage. One participant learned to preserve food through canning after watching her mother's memory slip and deciding she needed to take over. She made clear the memories before, during, and after made the learning relevant; canning became part of this participant's identity. This was not the case for the learner who prepared a video using Adobe premiere for a scholarship. The scholarship, an external motivator, may have been the carrot, and thus this learner may not have been truly intrinsically motivated. Perhaps some learners are pulled as often as they push themselves.

Finally, the use of learning tools – including ICTs – enables SDL, with individuals perceiving affordances based on their preferences and values (Dings, 2020; Norman, 1999). Various learning tools, digital or not, presented opportunities for users to learn in ways that matched their tendencies, connect past knowledge with new knowledge, and share knowledge and discoveries with others, much as Cabrero and Román (2018) and Siemens (2006) argued. What has become abundantly clear is despite users integrating similar technologies (e.g., videos), how they used them varied. Evidence suggests learners experience shifts in interests and needs (Downes, 2010) and utilize learning tools to best fit those requirements based on what the technology will offer them.

This study acknowledges that the affordances perceived exist with some overlap. A learner who chooses to use a video could do so because the video was perceived as high quality (accessibility), was visual (personalizability), and could be paused and replayed later (adaptability). While the current study does not tackle this overlap, I would argue the affordances perceived in the learning tools build. To seek personalizability, it seemed learners first moved through access – but did not always highlight this as an opportunity of the tool. Future research should tease this out and determine if multiple affordances are perceived simultaneously or if one affordance is perceived to a greater or lesser degree.

Contributions to Research

The current study explores SDL through Deci and Ryan's (2000) Self-Determination Theory and specifically highlights the myriad ways learners satisfy their learner needs, self-regulate, and perceive affordances of learning tools. Based on the current findings, I argue that SDT extends into and provides a framework to study informal contexts, that fluidity exists in the lanes of learning, that learner choice and voice is of prime importance to learners, that learners

took advantage of *weak ties* during informal learning, and that extrinsic motivation is present during informal learning.

First, SDT applies to and helps us understand learning in informal contexts. What has been made increasingly clear is learning contexts do not exist in isolation, and that learners bring their tendencies for one context into another. SDL is not exclusively informal. This means adults who engage in SDL in formal spaces may utilize some of the same tendencies they do in informal environments. Through the theorized Lanes of Learning model, I argue distinct patterns exist to explain self-directed learning; these patterns can be organized around autonomy, competence, and relatedness, self-regulation, and perceived affordances. That SDL can be organized around the tenets of SDT means scholars have unified language to discuss self-directed learning regardless the context (Deci & Ryan, 2000; Waldeck & LaBelle, 2016).

Second, there is perhaps more fluidity between lanes than the model suggests. Learners showed tendencies toward specific strategies or processes both because of who they are (i.e., learner) *and* what they were learning. Participants who noted multiple learning topics as well as participants from the pilot study indicated they took distinct steps depending on what they were learning. This transcends informal contexts. Learning in formal spaces has consistently become more complicated as learners do not always see the relevance of the content. SDL provides a remedy. Because SDL is tied to a learner's experiences, one topic may have relevance while another does not (Dewey, 1916; Downes, 2010). Knowing this means we can more systematically study self-direction regardless the context and understand tendencies to learn what, how, when, and where learners choose. In this case, it becomes less about the specific environment and more about the means of completing the episode.

Third, learner choice and voice emerged as undeniable benefits of SDL. Several participants indicated they could not learn something they did not want to learn, and, moreover, did not want to learn by following another's commands. Several participants claimed their learning was not done – and likely would never be. Even when *coache*s were involved in learning episodes, their involvement was controlled by the learner. This choice and voice evolved into clear lane goals: efficiency (A), mastery (B), depth (C), or innovation (D). Learners in different lanes, while perhaps valuing each goal, prioritize only one. For example, a Lane A learner may learn to crochet in isolation *or* with others. Two Lane B learner could choose to learn piano but break the episode into different chunks. A Lane C learner may discuss *trial-and-error* after they have already chased down an answer while a Lane D learner explore as a form of innovation. In short, no two individuals embraced the same topic in the same manner, so the role of choice and voice is only further highlighted. This would also suggest that, were the same learner to engage in multiple learning topics, he or she may not take the same lane every time. The fluidity between lanes, and more importantly, what pushes learners to choose innovation over structure (or vice versa) lends credence the nature of and learners' control during SDL.

Fourth, findings indicate learners may involve *weak tie* connections during informal learning. The breadth of a learner's network has opened possibilities for informal learning interactions with experts who would otherwise not have been accessible. A tie's strength stems from the duration, frequency, and consistency of as well as the emotional intensity during interactions (Granovetter, 1973). What's interesting is learners sought weak ties when they needed precise teaching (i.e., a coach) and stronger ties when they needed emotional support. Interesting, *fans* were collectively seen as less important than *coaches* or *team members*, perhaps because fans could provide nothing but inconsequential, emotional support. Most often, fans

were parents, siblings, significant others, spouses, neighbors, roommates, or best friends – individuals who would already possess a spot in the learner's network, but not a source with perceived topic expertise. Team members were often the same people, but because they shared a language, could provide a type of camaraderie. Coaches were *found* and *added* to the network. Because coaches needed to have only perceived expertise, learners were as inclined to consult a friend's mom who is an engineer as they were the guys at Home Depot.

Fifth, though informal learning is suggestively void of extrinsic motivation – learners should *want* to learn – participants in this study communicated differently. Informal learners valued learning, but not all were equally motivated (e.g., some participants pushed themselves while others were pulled). Past motivation models suggest *affective learning* directly influences motivation (see Frymier, 2016). This study further supports this claim. Learners in Lane A were extrinsically motivated to complete a task but perhaps intrinsically motivated about the overall project. For instance, a participant taught himself to use a video editing software to apply for a scholarship; he must have felt intrinsically motivated to start. He valued the project but was not *as* motivated to learn the video editing. (It must be pointed out that, overall, participants in this study were highly motivated; Lane A learners were still above-average on state motivation.) Confirmatory research is needed to disentangle what comes first in informal contexts.

Implications for Instructors

The above findings present several practical implications for instructors at all levels, especially instructors wishing to increase opportunities for SDL. First, this LOL model may aid instructors who wish to incorporate more Differentiated Instruction [DI] (Tomlinson, 2014). Second, I argue instructors can both increase opportunities for choice and voice, allowing

students to use learning technologies in ways connected with their preferences through *Crossover Learning* (Sharples et al., 2015). Both are expanded upon below.

The theorized Lanes of Learning model can be used by instructors looking to differentiate instruction within their classrooms. An instructor who differentiates meets the needs of all diverse learners (Tomlinson, 2014). Participants in this study had varied and complex needs that, when in a formal setting, would need to be met. That these needs are complex is not surprising, as adult learners 1) need to know why they are learning something; 2) base self-concept on self-direction; 3) use prior experiences to bridge new concepts; 4) learn when they need to because of a life situation(s); 5) use education to fulfill life's potential; and 6) have internal rather than external motivation (Knowles et al., 2005). An instructor who differentiates would work with these students in unique ways that satisfy these needs; but as any instructor knows, there's just not enough time to differentiate like that. I argue this model may help allow for some of that work.

Learners take multiple learning paths. When learners approach similar learning challenges, they act in distinct ways. These tendencies would appear in the formal classroom space as well, though because the instructor maintains control, these tendencies may not be acted upon by students. Importantly, instructors cannot directly motivate students (Christophel, 1990); in a classroom setting, instructors create conditions that allow for intrinsic motivation. Regardless of what an instructor does or does not do, not all learners in every classroom seek *mastery*, *depth*, or *innovation*; some students may equate a course with a task, one that must be *efficiently* completed. To differentiate would be to equally satisfy these conditions for all learners.

To make the abstract concrete, in the communication basic course, students may approach the same assignment (i.e., a self-directed speech assignment) in four unique ways.

- A student approaching the assignment from Lane A might not want to be there, does not find the material relevant, and may engage in a Lane A behavior. This student may view this assignment as just another item to check off the list. Outside of the classroom, this student may choose to complete a project in one sitting – the night before its due – rather than take advantage of the scaffolding provided. This student will likely rely on the instructor's feedback as evidence of learning and involve others only if necessary.
- A student approaching the assignment from Lane B might chunk the project, and as they see more evidence of their skills improving, may begin to personally increase the challenge. Their motivation comes from potential mastery. This student will follow a graphic organizer or exemplar carefully, understanding these structures as essential to success. Feedback from the instructor will guide the student for much of his/her learning, and involvement from others is primarily functional.
- A student approaching the assignment from Lane C might start on course but diverge as new information becomes relevant. This student is likely to include too much information in the speech; depth of knowledge is important to this student. In Lane C, a student is likely to involve others for relational purposes and to rely on self-assessed understanding.
- A student approaching this assignment from Lane D might decide to try something new. Those in Lane D prioritize innovation, so this student may deviate from the

expected plan set forth and do things in creative, albeit unexpected, ways. This student relies on confidence and involves others to further expand their network. Instructors who are aware of these approaches can better support them. Often, early in the semester, I ask students how they learn best. By mapping students' answers to these Lanes of Learning, I can meet learners' diverse needs and differentiate in subtle ways. This may be further fueled through ICTs and Crossover Learning.

Second, student choice and voice can be provided for during Crossover Learning, which leverages the benefits of both informal and formal learning spaces. For learners to be considered self-directed, they must 1) have choice and voice and 2) believe their actions will be effective (Bonk & Lee, 2017; Cerasoli et al., 2016). Crossover Learning permits both in a way that maximizes learning benefits. A simple example is a museum trip: instructors can provide learners a single, critical thinking prompt and then allow learners to explore. Learners explore, which means learners are guided by a goal but can get there however they choose. Crossover learning amplifies learners' interests, provides choice and voice, and supports learners in "recording, linking, recalling and sharing their diverse learning events" (Sharples et al., 2015, p. 3). Crossover Learning combines student choice and voice with instructor feedback and guidance in a way that benefits learners, first.

Based on the evidence, I would further argue instructors can allow for both DI and Crossover Learning through the smart integration of ICTs. Participants in this study utilized learning tools that aligned to larger goals. Instructors can allow students to differentiate and to crossover by allowing them to use tools best aligned to their needs, regardless an instructor's personal belief toward those devices. It is possible to engage learners in formal spaces by permitting this blurring of boundaries. The increased use of technology in and out of the

classroom make this crossing over faster, easier, and smoother. Scholars are divided whether this technology is a benefit or a detriment for students (Dabbagh & Kitsantas, 2018). Both can be (and are) true. Allowing learners to use learning tools of their choice permits them to perceive affordances important to them in that context. It is not the tool but what the tool can provide that becomes important.

Throughout this dissertation, I have argued that formal and informal learning contexts cannot be equated. This is still true. However, learning contexts exist on a continuum, rather than dichotomies, so a formal or informal space need not be only one thing. Within formal spaces, informality is possible. Within formal spaces, SDL is possible. And to integrate these, instructors do not have to give up all control. Learners in this study indicated having access to a large number of resources or having resources they can manipulate aids their learning. Both can be done in formal settings. Especially in the wake of the pandemic when so many course lectures became mediated, learners thrived on this freedom to control just the learning resource (McMurtie, 2021). This can be expanded by increasing opportunities for learner freedom but does not have to be at the expense of rigor or standards. Further, learners in this study who preferred innovation and trial-and-error collected, predominately, affirming cues. In classroom spaces, instructors can capitalize on this by allowing for more self-assessment and reflection but often don't because of the same formal requirements that inhibit intrinsic motivation (Blum, 2020). Perhaps we can solve one with the other.

Limitations

This study is not without limitations, which limit the transferability of these results to other settings. First, participants in both the pilot and open-ended survey phases held varying definitions of *self-teaching* or *informal learning*. This is not surprising as these terms are not

commonly used and, when they are, are often described by different terms. The definitional ambiguity between informal learning and self-directed learning (see Carliner, 2013) may have resulted in participants describing significantly different experiences. More work can be done on definitional unity and in better parsing out the distinctions in learning contexts – especially in such a technologically-connected world.

Second, this dissertation did not account for extrinsic motivation. A large external factor for all participants in this study was the COVID-19 pandemic. Data collection occurred both immediately before and during the height of the pandemic. Pilot study data were collected in the month prior to universities shifting to online education. By the time data subsequent data were collected, the pandemic altered what "normal" learning looked like. Consequently, some participants indicated only engaging in some self-teaching because of the increased time from quarantine. Perhaps learners' motivation to engage in self-teaching was higher because everything else around them was in chaos. The role of external factors, such as the pandemic, when self-teaching should be further explored.

Third, analysis regarding perceived affordances was impacted by artifact of the method that prevented thorough exploration of all affordances instead of just the most dominant. It became clear learners did not utilize learning tools, including ICTs, in single or narrow way; rather, learners valued when tools could be used to meet multiple needs. For instance, a visual resource could also be paused; if this is the case, which affordance is perceived as most salient? Future work should seek an understanding of all tools, not just the most *impactful* (a term not defined for participants and thus, difficult to code).

Future Directions

Several future directions for research exist in response to this study. First, it is clear learners make attributions during self-directed learning both regarding what prompts them to initiate and whether they view themselves as successful. Applying an Attribution Theory (Weiner, 1972) lens would allow us to determine if runners in distinct lanes are prompted by external causes.

Second, this study reveals the importance of *resilience* in learning contexts; to this, two links to past constructs can be made and explored: Growth Mindset (Dweck, 2008) and Self-Efficacy (Bandura, 1999). Dweck argues learners have a *growth* mindset when they see their skills, knowledge, and abilities as able to change – as opposed to a *fixed* mindset. Self-efficacy labels the belief one has in their future abilities. What was clear from this project was learners who hit significant roadblocks could choose to give up or could choose to press on. Resilience seemed to make the difference. More attention can be placed on resilience or these similar constructs in informal environments.

Third, there may be generational effects. For this project, though the range of learners was extensive, the median age was close to that of *traditional* college students (*median* = 23). One participant, age over 50, indicated their learning methods are influenced by what they did when they were younger. This is important as some learners in this study performed in ways parallel to formal environments, but not all. It would be interesting to see how these lane preferences shift over time, or if they would at all. Lifelong learning invites multiple learning strategies.

Fourth, other distinct research methods should be conducted to further triangulate these findings. Confirmatory analysis in the shape of statistical analysis could depict relationships or

differences between runners in each lane and other variables. In-depth interviews with both participants from this study and new participants could illuminate other nuanced perspectives that may not have been reflected in this project.

Finally, future research should compare informal and formal contexts, especially regarding outcomes such as retention, satisfaction, and grit/resilience. In informal contexts, because learners internalize material to a different degree, and potentially a more personal degree, they may be able to learn *more* throughout the context; however, given some learners are more interested in completing a task than learning new content, they may not learn the right material. A study comparing perceptions of persistence would help us determine how "effective" learners are in motivating, and as a result, teaching themselves.

Sixth, researchers should more deeply explore self-assessment. Self-assessment as an internal, constant, and transformative appraisal wherein students come to value their work and accomplishments, but as a pedagogical strategy, is rarely implemented and, when it is, only as a secondary level (Boud, 1995). It seemed, from the collected evidence, individuals may not know *how* to self-assess, and what's worse, may wait for external validation before determining personal success. Several participants tried to *justify* rather than celebrate their learning. As classroom instructors shift to more *ungrading* practices (see Blum, 2020) and utilize self-assessment as a pivotal component, research must address how students communicate their learning.

Conclusion

This project set out to understand how some self-directed learners engage in self-directed learning. Ultimately, findings revealed four patterns to explain how self-directed *learners* engage in self-directed *learning*. These patterns and their associated behaviors coalesce in a Lanes of

Learning model of self-directed learning. The *lane* preferred by a *runner* then influences what learning strategies are used, how they assess competence, who they involve and why, and what affordances they perceived. Learners' larger goals also influenced which learning tools they integrated and, from those, what they perceived as possible. Three primary affordances emerged, including *accessibility*, *personalizability*, and *adaptability*. In short, learners in 1) Lane A preferred efficiency, collected confirming cues, involved others to meet a goal, and used tools that provided a set of correct steps; 2) Lane B preferred structure, collected confirming cues and added affirming cues, involved others for functional purposes, and used tools that most resembled the *real thing*; 3) Lane C preferred depth and chase information as it becomes relevant, collected affirming cues, involved others for emotional reasons, and used tools that allowed more opportunities to chase information; and, 4) Lane D preferred innovation, collected affirming cues but may seek a confirming end, involved others to build a network, and used tools that were more inspirational than educational. In short, these findings lend support to a very important notion: not all self-directed learners self-regulate in the same way. People *are* motivated to learn – when that learning is on their terms – and this motivation manifests in the strategies and processes taken by individual during learning.

The COVID-19 pandemic shifted much regarding how, what, when, and where people learn. Today's learners are not restricted to a classroom – and they know it. Participants named the plethora of apps, websites, and other learning tools as enabling self-teaching in places beyond the formal context. Moreover, once learners had control, they made choices and pursued learning techniques that adhered to what mattered to them in that moment. Learners assess competence, involve others, and select learning tools that provide the most opportunities – independently. Participants recognized, as Tabia summarized, "you don't really need a teacher to learn stuff."

As we transition back to pre-pandemic teaching and learning – whatever that may be – we must remember it is not only the classroom that serves as a site of learning, and it is not only the teacher who holds knowledge. Through DI or crossover learning, instructors can incorporate elements of SDL into their classroom and reap the benefits of both formal and informal contexts.

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APPENDIX A: PILOT STUDY PSEUDONYMS

Ava
Benjamin
Bradley
Chase
Daniella
Emma
Evan
Harrison
Jennifer
Mirabelle
Nija
Oliver
Ross
Sharon
Tabia
Tamara
Victoria
Zoe

APPENDIX B: PILOT RECRUITMENT FORM

My name is Carrie Anne Platt and I am an Associate Professor in the Department of Communication. I am interested in learning more about what you do when you teach yourself something. We will engage in a conversation regarding how you go about self-teaching, including the sources or programs you may use. This research is designed to show what students do when they learn beyond the classroom.

You will earn 10 research credit points in COMM 110 for participating in this study.

To qualify for this study, you must be:

- 18 years of age or older
- A student at NDSU

As part of the study, you can participate in a 20 to 30-minute interview to be held in a private room at NDSU. We will discuss your learning practices in and out of the classroom with special attention on how this learning benefits you.

If you would like to participate in this study, you can sign up using the link(s) below:

For a one-on-one interview, click <here>

There are minimal risks involved in this research project. All responses will be kept confidential. Your name will not be used in the transcripts but will be kept on a list that will be used in the event you wish to withdraw from the study after completing the interview. Participation is entirely your choice, and you may change your mind or quit participating at any time prior to publication of results. Only the principal investigator and the research team will have access to the records from this study.

This study is approved by the NDSU IRB (#HS20176).

If you have any questions about the rights of human participants in research or to report a problem, contact the NDSU IRB office at 701-231-8995, 1-855-800-6717 (toll-free), or ndsu.irb@ndsu.edu.

If you have any questions about this research study, please contact me at 701-231-7294 or carrieanne.platt@ndsu.edu.

Thank you,
Carrie Anne Platt
Associate Professor of Communication
Associate Dean of Undergraduate Education – College of Arts, Humanities and Social Sciences
North Dakota State University
Department #2310 • P.O. Box 6050 • Minard 338B12
Fargo, ND 58108-6050

APPENDIX C: PILOT INTERVIEW PROTOCOL

1) Let's start by thinking of something you were interested in and learned about on your own.
    a. What is it that you wanted to learn?

    b. Why did you want to learn this?

    c. How did you engage in the learning opportunity?

    d. What type(s) of tools/services did you use for this learning?

    e. What made these tools/services effective?

    f. How did you know you'd actually learned something? How did you apply the new knowledge?

    g. Was there an instructor or expert from which to learn? Were there peers or other learners from which to learn?

    h. How is this different than the way learning works in the classroom?

2) What is something you are interested in that you would learn about on your own?
    a. How would you go about learning this?

    b. *In reference to an example pulled up by the participant:* Why this tool?

APPENDIX D: PILOT INFORMED CONSENT

Department of Communication
P.O. Box 6050 • Minard 338
Fargo, ND 58108-6050
Phone: 701-231-7750

Students' Understanding of Informal Learning

This consent form is designed to inform you about the study you are being asked to participate in. Here you will find a brief summary about the study; however, you can find more detailed information later on in the form.

- This study focuses on students' understandings of informal learning
- You can participate if you are:
  - At least 18 years of age
  - A student at NDSU
- There are minimal potential risks associated with this study. There are no individual benefits, but your responses will help instructors create policies that are realistic, fair, and positive for the overall learning environment. You will receive 10 points of research credit in COMM 110 for participating in this study.
- Participation in this interview should take 20-30 minutes.
- Your responses will be kept confidential.

This study is being conducted by: Carrie Anne Platt, Ph.D. & Kyle R Vareberg, MA

Key Information about this study:

Why am I being asked to take part in this study?

You are being asked to take part in this study because you are 18 years of age or older and currently enrolled at NDSU.

What will I be asked to do?

You are being asked to participate in an individual interview to explore your understandings of informal learning opportunities.

Where is the study going to take place, and how long will it take?

The interview will take place in a private room in the Department of Communication (Minard

338). The interview will last approximately 20-30 minutes.

 **What are the risks and discomforts?**

It is not possible to identify all potential risks in research procedures, but our research team is taking safeguards to minimize any known risks to you as a research participant, particularly when it comes to keeping your responses confidential**.** You may feel uncomfortable discussing distractions you have faced during your first year at NDSU. You can refrain from answering any particular question and stop participating at any time.

 **What are the expected benefits of this research?**

Individual Benefits: There are no individual benefits associated with this study.

Societal Benefits: This research will help instructors better understand how students feel about technology use policies. We will use your responses to identify how instructors can create policies that are realistic, fair, and positive for the overall learning environment.

Do I have to take part in this study?

Your participation in this research is voluntary. If you decide to participate in the study, you may change your mind and stop participating at any time without penalty.

What are the alternatives to being in this study?

As an alternative to participating in this study, you may choose to not participate. If you are in COMM 110 and need research points, there will be other research opportunities offered to COMM 110 students this semester as well as an alternative assignment that can be completed for the 10 research credit points.

 **Who will have access to my information?**

I am the only one that will be able to connect your responses with your name and demographic information. I will ensure confidentiality of your responses by replacing your name with a pseudonym in the transcript of your interview and any research articles resulting from this study.

Can my participation in the study end early?

You may choose to stop participating in the interview at any time. After your interview is over, you can choose to withdraw from the study up until the point where results have been disseminated.

 **Will I receive any compensation for participating in the study?**

You will receive 10 research credits in COMM 110 for participating in the study. If you are not in COMM 110, no compensation will be provided.

What if I have questions?

Before you decide whether you'd like to participate in this study, please ask any questions that come to mind now. Later, if you have questions about the study, you can contact me at carrieanne.platt@ndsu.edu or 701-231-7294.

What are my rights as a research participant?

You have rights as a research participant. All research with human participants is reviewed by a committee called the *Institutional Review Board (IRB)* which works to protect your rights and welfare. If you have questions about your rights, an unresolved question, a concern or complaint about this research you may contact the IRB office at 701.231.8995, toll-free at 855-800-6717 or via email (ndsu.irb@ndsu.edu).

Documentation of Informed Consent:

You are freely making a decision whether to be in this research study. Signing this form means that

1. you have read and understood this consent form
2. you have had your questions answered, and
3. you have decided to be in the study.

You will be given a copy of this consent form to keep.

_____ _____

Your signature Date

_____ _____

Your printed name Date

_____ _____

Signature of researcher explaining study Date

_____

Printed name of researcher explaining study

APPENDIX E: PILOT DEMOGRAPHIC QUESTIONNAIRE

This information will help us better understand differences in students' perceptions of technology use policies.

1. Gender

☐ Male
☐ Female
☐ Other

2. Race/Ethnicity

Please select your race/ethnicity from the choices provided:

☐ African American
☐ American Indian
☐ Asian/Pacific Islander
☐ Latino/Hispanic
☐ Middle Eastern
☐ White/Caucasian
☐ Multiracial (please specify: _____)
☐ Prefer not to respond
☐ Other: _____

3. Current Age

_____

4. What is your academic year (by credits)?

☐ Freshmen (0-30 credits)
☐ Sophomore (31-60 credits)
☐ Junior (61-90 credits)
☐ Senior (91-120 credits)

5. What is/are your academic major(s)?

_____

APPENDIX F: OPEN-ENDED SURVEY RECRUITMENT NOTICES

Recruitment Notice: Email Listservs

Have you ever taught yourself something?

My name is Carrie Anne Platt and I am an Associate Professor in the Department of Communication at North Dakota State University. I am interested in learning more about how people approach the process of teaching themselves new skills or subjects. This might include teaching yourself the skills needed to complete a project (e.g., refinishing a floor) or teaching yourself a subject of interest (e.g., history of your community).

You do not have to be a student at any university to participate in this study.

But, you should:

- Be 18 years of age or older
- Recall a moment where you taught yourself something

If you would like to participate, you will be presented with and asked to answer brief questions about your experience. Some questions will be scales while others will be more open-ended responses. The average completion time is 15-20 minutes.

You may also opt-in for a potential follow-up interview. These interviews will occur starting January 2021. Opting-in will enter you into a drawing for **one of five $20 Amazon gift cards**. You do not have to be interviewed a second time to win the gift cards.

If you would like to participate in this study, you can access the link by clicking here.

There are minimal risks involved in this research project. All responses will be kept confidential. Your name will not be used but will be kept on a list that will be used in the event you wish to withdraw from the study after completing the interview. Participation is entirely your choice, and you may change your mind or quit participating at any time prior to publication of results. Only the principal investigator and the research team will have access to the records from this study.

This study is approved by the NDSU IRB (#IRB0003340).

If you have any questions about the rights of human participants in research or to report a problem, contact the NDSU IRB office at 701-231-8995, 1-855-800-6717 (toll-free), or ndsu.irb@ndsu.edu.

If you have any questions about this research study, please contact me at 701-231-7294 or carrieanne.platt@ndsu.edu.

Thank you,
Carrie Anne Platt
Associate Professor of Communication

Recruitment Notice: Social Media

Social Media (Facebook)
Hey all – I'm working on my dissertation and need your help.

Can you recall a time you taught yourself something? That might include teaching yourself the skills needed to complete a project (e.g., refinishing a floor) or teaching yourself a subject of interview (e.g., history of your community). If so, I'd like you for a research study. This research explores a moment when you taught yourself something; you will be presented with and asked to answer brief questions regarding this experience. The average time for completion is 15-20 minutes. **You do not have to be enrolled or a registered student to participate in this study.** Additionally, you may also opt-in for a follow-up interview and a chance to **win one of five $20 Amazon gift cards**. And don't forget to share the link. Access to the survey may be found at this link.

Social Media (Twitter)
Have you taught yourself something (e.g., fixing a floor OR community history)? If so, I'd like you to answer some brief questions. You don't have to be a student to participate. You may opt-in for a follow-up interview and a chance to win 1-of-5 $20 Amazon gift cards. Access the survey here. And don't forget to share the link.

APPENDIX G: OPEN-ENDED SURVEY INSTRUMENT

NDSU **North Dakota State University**
Department of Communication
P.O. Box 6050 • Minard 338
Fargo, ND 58108-6050
Phone: 701-231-7750

Understanding Self-Teaching

My name is Carrie Anne Platt, a Professor in the Department of Communication at North Dakota State University (NDSU). This study explores how people teach themselves. This might include teaching yourself the skills needed to complete a project (e.g., refinishing a floor) or teaching yourself a subject of interview (e.g., history of your community).

To participate in this study, you must be at least 18 years old. Also, you want to make sure you can describe a moment when you taught yourself something.

You do <u>not</u> have to be a student to participate.

To complete this study, you will be asked a series of questions regarding your experience teaching yourself. Some of these questions will ask you to respond to scales while others will ask you to write a response in your own words. You may use as much detail as you are comfortable sharing.

At the end of this questionnaire, you may opt-in to a follow-up interview. Opting-in will put you in a drawing for **one of five $20 Amazon gift cards**. You do not have to be interviewed a second time to win a gift card.

Completing this questionnaire will take roughly 15-20 minutes; this includes time to read this information form as well as time to answer brief demographic questions.

If you participate in a follow-up interview, these will last roughly 30-35 minutes. No further demographic information will be collected during these interviews. These interviews will be scheduled starting **January 2021.** Follow-up interviews will be audio recorded. All research records will remain private. When the interview is transcribed, you will be given a pseudonym, and other potentially identifying information will be left out of the transcripts. In any written documents (including publications) regarding the study, only pseudonyms will be used. Audio files will be stored in a password protected file on a computer that is only accessible to the principal investigator and co-investigators. Electronic copies of the interview transcripts will be saved and protected in the same fashion. After the data has been analyzed, the audio recordings will be deleted.

If you have questions about the study, you can contact me at 701-231-7294 or <u>carrieanne.platt@ndsu.edu</u>.

You have rights as a research participant. If you have questions about your rights or complaints

about this research, you may talk to the researcher or contact the NDSU Human Research Protection Program at 701-231-8995, toll-free at 1-855-800-6717, by email at ndsu.irb@ndsu.edu, or by mail at: NDSU HRPP Office, NDSU Dept. 4000, P.O. Box 6050, Fargo, ND 58108-6050.

Thank you for your taking part in this research.

This project focuses on your experiences self-teaching. For example, I may teach myself new information (i.e., basics of architecture) a new skill (i.e., cooking), or a combination of the two (i.e., rewiring an outlet). In the space below, please indicate what you taught yourself.

Q1. I taught myself… _____

The remainder of this project focuses on your experience teaching yourself {Q1}. I will be asking questions about various steps of the process, the resources you used, etc. Writing 2-3 sentences for each response helps me make sure I understand your experiences and perspective. You are, of course, welcome to write more.

Q2. My first question focuses on your self-teaching process. When teaching yourself {Q1}, how did you start? What did you do after that? What did you do to complete your learning?

Q3. What challenges did you face when teaching yourself {Q1}, and how did you overcome these?

Q4. During your self-teaching, how could you tell you were making progress? What types of benchmarks did you set for yourself?

Q5. Let's move our focus to the resources you used. When teaching yourself {Q1}, what specific resources did you use? What value did you see each resource adding to your learning? Feel free to bring up more than one example, if necessary.

Q6. Of all the specific resources you've listed above, which was the most helpful? What was it that made that resource helpful?

Q7. Let's talk about any other people who may have been involved in your self-teaching experience. Before, during, and after teaching yourself {Q1}, who did you interact with? What did those interactions look like?

Q8. How important were these interactions to your learning process?

Let's talk now about how you feel your self-teaching went.

Statement	Strongly Disagree			Neither Disagree or Agree			Strongly Agree
Q9. I was successful in teaching myself {Q1}.	1	2	3	4	5	6	7

Q10. How did you make this determination?

Q11. What would have prevented someone else from teaching him/herself {Q1}?

Q12. Please describe a time when you attempted to teach yourself something and you were not successful. How does this compare with the experience you described previously?

State Motivation to Learn
Let's move to your levels of motivation when teaching yourself {Q1}.

Below, you will see pairs of opposite words. When selecting your answer, the closer you are to the word, the more that describes you. There is no correct answer.

How did you feel about teaching yourself {Q1}?

Motivated	1	2	3	4	5	6	7	Unmotivated
Interested	1	2	3	4	5	6	7	Uninterested
Involved	1	2	3	4	5	6	7	Uninvolved
Not stimulated	1	2	3	4	5	6	7	Stimulated
Don’t want to study	1	2	3	4	5	6	7	Want to study
Inspired	1	2	3	4	5	6	7	Uninspired
Unchallenged	1	2	3	4	5	6	7	Challenged
Uninvigorated	1	2	3	4	5	6	7	Invigorated
Unenthused	1	2	3	4	5	6	7	Enthused
Excited	1	2	3	4	5	6	7	Not excited
Aroused	1	2	3	4	5	6	7	Not aroused
Not fascinated	1	2	3	4	5	6	7	Fascinated

Metacognition as Regulation
Let's move to what you did when teaching yourself {Q1}.

Believe, you will see a series of statements about the learning process. You should decide how much the statement is not like you (=1) or is like you (=5). Please only select one answer per line. There is no correct answer.

Statement	Not at all like me		Unsure		Exactly like me
I pace myself while self-teaching in order to have enough time.	1	2	3	4	5
I think about what I really need to learn before I begin a task.	1	2	3	4	5

I set specific goals before I begin a task.	1	2	3	4	5
I ask myself questions about the material before I begin.	1	2	3	4	5
I think of several ways to solve a problem and choose the best one.	1	2	3	4	5
I read instructions carefully before I begin a task.	1	2	3	4	5
I organize my time to best accomplish my goals.	1	2	3	4	5
I slow down when I encounter important information.	1	2	3	4	5
I consciously focus my attention on important information.	1	2	3	4	5
I focus on the meaning and significance of new information.	1	2	3	4	5
I create my own examples to make information more meaningful.	1	2	3	4	5
I draw pictures and diagrams to help me understand while self-teaching.	1	2	3	4	5
I try to translate new information into my own words.	1	2	3	4	5
I use the organizational structure of the text/resources to help me learn.	1	2	3	4	5
I ask myself if what I'm reading is related to what I already know.	1	2	3	4	5
I try to break self-teaching down into smaller steps.	1	2	3	4	5
I focus on overall meaning rather than specifics.	1	2	3	4	5
I ask myself periodically if I am meeting my goals.	1	2	3	4	5
I consider several alternatives to a problem before I answer.	1	2	3	4	5
I ask myself if I have considered all options when solving a problem.	1	2	3	4	5
I periodically review to help me understand important relationships.	1	2	3	4	5
I find myself analyzing the usefulness of strategies while I self-teach.	1	2	3	4	5
I find myself pausing regularly to check my comprehension.	1	2	3	4	5
I ask myself questions about how well I am doing while self-teaching something new.	1	2	3	4	5
I ask others for help when I don't understand something.	1	2	3	4	5
I change strategies when I fail to understand.	1	2	3	4	5
I re-evaluate my assumptions when I get confused.	1	2	3	4	5
I stop and go back over new information that is not clear.	1	2	3	4	5
I stop and reread when I get confused.	1	2	3	4	5
I ask myself if there was an easier way to do things after I finish a task.	1	2	3	4	5

I summarize what I've learned after I finish.	1	2	3	4	5
I ask myself how well I accomplish my goals once I'm finished.	1	2	3	4	5
I ask myself if I have considered all options after I solve a problem.	1	2	3	4	5
I ask myself if I learned as much as I could have once I finish a task.	1	2	3	4	5

Affect toward Content

Let's move to how you felt when teaching yourself {Q1}.

Below, you will see pairs of opposite words. When selecting your answer, the closer you are to the word, the more that describes you. There is no correct answer.

I feel the content I've learned is…

Bad	1	2	3	4	5	6	7	Good
Valuable	1	2	3	4	5	6	7	Worthless
Unfair	1	2	3	4	5	6	7	Fair
Positive	1	2	3	4	5	6	7	Negative

Demographics

Instructions: Please answer these questions regarding yourself.

1. Please mark your gender
   - ☐ Gender non-binary
   - ☐ Man
   - ☐ Transgender Man
   - ☐ Transgender Woman
   - ☐ Two-Spirit
   - ☐ Woman
   - ☐ Another gender identity
   - ☐ Prefer not to respond
2. Please select your race/ethnicity.
   - ☐ African American
   - ☐ American Indian
   - ☐ Asian/Pacific Islander
   - ☐ Latino/Hispanic
   - ☐ Middle Eastern
   - ☐ White/Caucasian
   - ☐ Multiracial
   - ☐ Prefer to self-identify
   - ☐ Prefer not to respond
3. What is your current age? _____
4. What is your highest degree earned?
   - ☐ High school diploma/GED

- ☐ Associate degree
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Terminal degree
- ☐ Other

5. Are you currently enrolled as a student at any institute of higher education?
   - ☐ Yes
   - ☐ No
6. *if yes,* What is your academic program? _____
7. What is your academic year (by credits)?
   - ☐ Freshmen (0-30 credits)
   - ☐ Sophomore (31-60 credits)
   - ☐ Junior (61-90 credits)
   - ☐ Senior (91-120 credits)
8. *if no*, What is your current occupation. _____

Thank you for completing the survey. Your response has been recorded.

I will be conducting follow-up interviews based on these survey answers. If you are willing to participate in a follow-up interview, indicate below. You will be prompted to provide a best means of contact.

Everyone who indicates they are willing to do a follow-up interview will be entered into a drawing for one of five $20 Amazon gift cards, regardless of whether they are selected for an interview or not.

I am willing to participate in a follow-up interview.

- ☐ Yes
- ☐ No

if no, End of Survey

if yes, You've indicated a willingness to participate in a follow-up interview. Please provide the contact information below. I will reach out with details.

Name: _____

My best means of contact is…

- ☐ Email
- ☐ Phone

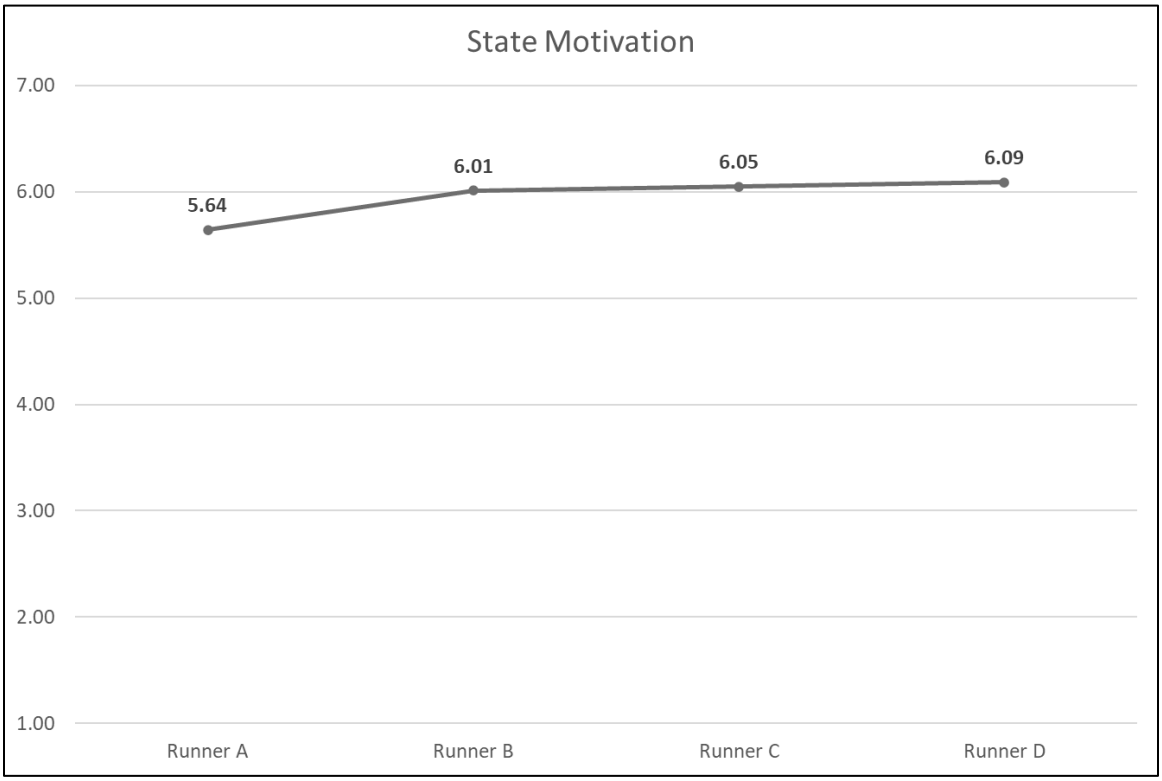
APPENDIX H: INITIAL SUMMARY OF CODES

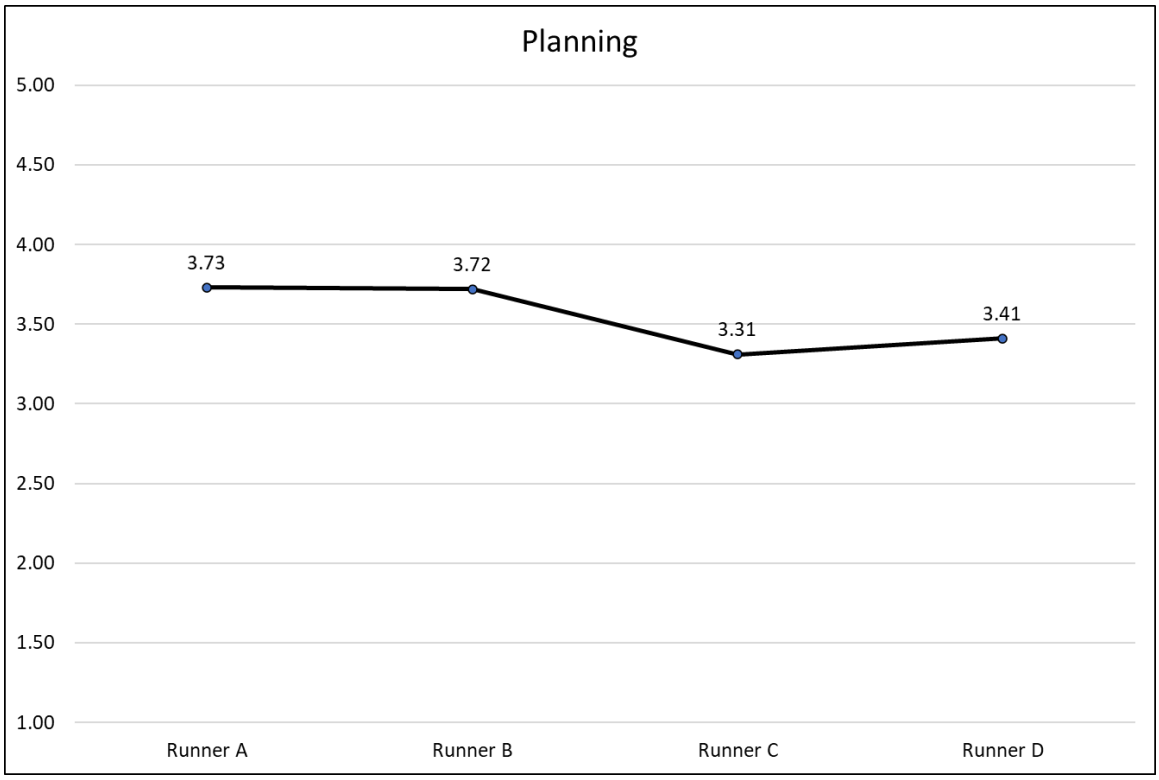
A. Motivation
   1. Autonomy
      a) Flexibility
      b) Initiation
      c) Resilience
      d) Investment of resources
      e) Learning incomplete
   2. Competence
      a) Evidence of learning
      b) Self-efficacy
      c) Accepting failure
   3. Relatedness
      a) Supporters
      b) Collaborators
      c) Teacher/Student
      d) Isolation

B. Self-regulation
   1. Background
      a) Accessing prior knowledge
      b) Getting the basics
      c) Casting a wide net
   2. Performing
      a) Chunking
      b) Experimenting
      c) Trial-and-error
      d) Practicing
      e) Scaffolding
      f) Mimicking
   3. Self-monitoring
      a) Establishing structure
      b) Setting personal standards
      c) Troubleshooting
      d) Pivoting
   4. Involving Others
      a) Seeking guidance
      b) Receiving support
   5. Evaluating
      a) Affirming
      b) Confirming

C. Affordances
    1. Accessibility
        a) Quantity
        b) Quality
        c) Correct
    2. Personalizability
        a) Catered
        b) Visual
    3. Adaptability
        a) Manipulate
        b) Mimic

APPENDIX I: MEAN PLOTS





APPENDIX J: LANES OF LEARNING AND AFFORDANCES SUMMARY

	Runner A		Runner B		Runner C		Runner D		Totals	
	N	%	N	%	N	%	N	%	N	%
Accessibility	16	41.03	21	42.00	12	48.00	18	45.00	67	43.51
To fast material	*4*	*10.26*	*8*	*16.00*	*1*	*4.00*	*5*	*12.50*	*18*	*11.69*
To quantities of materials	*7*	*17.95*	*5*	*10.00*	*3*	*12.00*	*3*	*7.50*	*18*	*11.69*
To quality material	*5*	*12.82*	*8*	*16.00*	*8*	*32.00*	*10*	*25.00*	*31*	*20.13*
Personalizability	14	35.90	12	24.00	7	28.00	12	30.00	45	29.22
Individualized	*7*	*17.95*	*7*	*14.00*	*7*	*28.00*	*6*	*15.00*	*27*	*17.53*
Visual	*7*	*17.95*	*5*	*10.00*	*0*	*0.00*	*6*	*15.00*	*18*	*11.69*
Adaptability	9	23.08	17	34.00	6	24.00	10	25.00	42	27.27
Manipulate	*5*	*12.82*	*12*	*24.00*	*3*	*12.00*	*5*	*12.50*	*25*	*16.23*
Mimic	*4*	*10.26*	*5*	*10.00*	*3*	*12.00*	*5*	*12.50*	*17*	*11.03*