Teaching Tools, Teachers' Rules: ScratchJr in the Classroom

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Melissa Su Ching Lee

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Advisor: Marina U. Bers

Committee: Marina U. Bers, PhD.; David Henry Feldman, PhD.; Benjamin Shapiro, PhD.

Abstract

ScratchJr is an introductory graphical programming language that was jointly created by Tufts University's Developmental Technologies Research Group, MIT's Lifelong Kindergarten Group and the Playful Invention Company. Over the past five years, the ScratchJr research team has collaborated with families and schools in order to understand how children use and understand ScratchJr. However, creating a developmentally appropriate technological tool like ScratchJr only addresses part of the experience that creates opportunities for children to learn. This thesis looks at how kindergarten teachers use ScratchJr in their classes and how teaching styles impact student learning. This thesis examined teaching styles in three dimensions: 1) classroom management, 2) instructional methods, and 3) amount of programming taught in class. Student learning outcomes were assessed on four dimensions: 1) engagement, 2) attentiveness, 3) collaboration, and 4) programming scores on ScratchJr "Solve-It" assessments. Results suggest that highly structured classrooms, student-led instructional methods, and high amounts of programming may lead to higher student learning scores. The findings also have implications for how teachers in early childhood education can integrate technology in their classrooms.

Keywords: teaching, programming, learning, early childhood education.

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List of Tables

Table 1. Data Collection Conducted in Fall 2013 15

Table 2.Teaching Styles – Dimensions and Examples 18

Table 3. Student Learning – Dimensions and Examples 20

Table 4. Mean Scores for Dimensions of Classroom Management 29

Table 5. Characteristics of High and Low Structure Classrooms 30

Table 6. Number of Students and Teacher's Interaction Style 32

Table 7. Mean Scores for Dimensions of Instructional Methods 35

Table 8. Characteristics of Teacher-Directed and Student-Led Classrooms 36

Table 9. Types of Questions Teachers Ask 37

Table 10. Programming Use in Classrooms 39

Table 11. Mean Scores for Dimensions of Student Learning 41

Table 12. Characteristics of Low and High Student Learning Classrooms 42

Table 13. Relationship Between Teaching Styles and Student Learning 44

Table 14. Correlation Between Individual Dimensions of Teaching Styles and Overall Student Learning 45

Table 15. Correlation Between Individual Dimensions of Teaching Styles and Student Learning 45

Table 16. Correlation Between Dimensions of Student Learning 46

List of Figures

Figure 1. Dimensions of Teaching Styles Observed 17

Figure 2. Dimensions of Student Learning Observed 19

Figure 3. Classroom Management Continuum 29

Figure 4. Teacher Working One-On-One Vs. Working in a Group 33

Figure 5. Instructional Methods Continuum 35

Figure 6. Overall Teaching Styles in Classrooms 38

Figure 7. Overall Teaching Styles with Amount of Programming 40

Figure 8. Overall Teaching Styles with Amount of Student Learning 43

Table of Contents

Abstract ii

Acknowledgements iii

List of Tables iv

List of Figures v

Chapter 1: Introduction 1

Chapter 2: Literature Review 4

Chapter 3: Research Design 12

Chapter 4: Methodology 23

Chapter 5: Analysis 27

Chapter 6: Results 28

Chapter 7: Discussion 46

Chapter 8: Limitations / Future Directions 52

Chapter 9: Conclusion 54

Chapter 10: References 56

Appendix A 67

Appendix B 68

Appendix C 77

Appendix D 82

Chapter 1: Introduction

Technology has grown to become such a part of our everyday lives that it is hard to imagine living in a world without it. Children are constantly exposed to different facets of technology, be it in their homes, schools, or community. This exposure to technology could be as passive as watching parents use a smartphone to take photos, text message and email; or as active as playing games, engaging with other children through social media or learning math and literacy skills with the help of a computer. With the growing impact of technology in our world, the use of technology in classrooms has also changed over the last forty years.

According to Koschmann (1996), there have been a few paradigm shifts in the way we use technology in the classroom. Computer-Assisted Instruction (CAI) was dominant in the 1960s and involved teachers using different instructional technologies that were designed as classroom aids. In this paradigm, the teacher was used as a transmitter of knowledge with specific tasks and outcomes for students. In the 1970s, the rise of artificial intelligence led to a more interactive use of technology to problem-solve, but the reliance on teachers as a conduit for which information and instruction would be passed continued to be dominant.

Piaget argued in his theory of constructivism that children learn by actively constructing knowledge themselves. This notion led to new methods of teaching in schools. Seymour Papert (1991) coined the term “constructionism” based on Piaget’s constructivist theory to describe the way learning how to program using computers could be an important part of constructivist learning. Constructionism marked a new way for students to learn using technology. Through the task of programming, students play the role of “teacher” by telling the computer what to do. The role of the teacher also shifted - instead of being the sole transmitter of knowledge; the teacher became a facilitator in this process.

With the push to encourage children to learn programming, there is currently a variety of programming tools, such as Logo, EToys, Crunchzilla Code Monster and Scratch. These programs are designed for children above the age of seven. However, there are very few programs available that address the learning and developmental needs of preschool and kindergarten children. Many of the existing programs are text heavy and require hand-eye coordination or fine motor skills in order to use the mouse or touchpad on the computer (Flannery et al., 2013; Hourcase et al., 2004.) These programs present a challenge to children in the preschool age group. However, research has shown that children in the preschool age group, as young as four years old, can grasp computer programming concepts and create robotics projects (Flannery et al., 2012; Bers, 2007).

With this in mind, the Developmental Technologies (DevTech) Research Group at the Eliot-Pearson Department of Child Development at Tufts University, together with the Lifelong Kindergarten group at the MIT Media Lab and the Playful Invention Company, created the ScratchJr is a graphical programming language that allows children ages 5-7 to create their own animated collages, interactive stories and games. The program has large blocks onscreen for easy manipulation and allows children to use the software with increasing complexity, as they get more comfortable with it. Children snap together graphical programming blocks to make their characters move, jump, hide, and sing. Children can modify characters in the paint editor, add their own voices and sounds, even insert photos of themselves in order to personalize their characters. The different learning opportunities found in ScratchJr allow children to explore and construct knowledge for themselves. This supports Papert's Constructionist theory (1991), highlighting how technology can support constructivist learning, as children become agents in their own learning process.

The development of ScratchJr began in 2010 and is a project that is funded by the National Science Foundation (NSF DRL-1118664). It is based on the Scratch programming software created by the Lifelong Kindergarten at the MIT Media Lab. The DevTech research group collected baseline data on how children use Scratch by observing children in grades K-6 using the program. They then held summer camps to teach children in grades K-2 Scratch, observing and learning how children use Scratch. Finally, they conducted focus groups with preschool teachers in order to gain insights into the creation of developmentally appropriate programming software for preschool children. The extensive process of research and user testing has helped make ScratchJr a developmentally appropriate tool for children (Flannery et al. 2013).

ScratchJr was also designed to be feasible for classroom use. According to Flannery et al., this was done by making sure that the interface and design allowed large groups of children to use it independently (2013). ScratchJr supports “foundational knowledge structures” such “sequencing, estimation, prediction, composition and decomposition” (Flannery et al., 2013, p. 8). The program was also designed to meet learning outcomes in three areas: 1) Discipline-specific knowledge such as Math and Literacy, 2) Foundational knowledge such as sequencing skills and pattern recognition, and 3) Problem-solving skills where students learn how to test and troubleshoot projects they create (Kazakoff, 2014). Embedded in the program are also opportunities to teach math, literacy and other cognitive skills to children in preschools (Flannery et al., 2013)

The current version of ScratchJr is available on the iPad. This is a positive development for the next phase of ScratchJr development. The iPad is cheaper and more portable than the personal computer and laptop and the touchscreen interface is easy to use and intuitive. Despite the fact that the iPad is a relatively new tool (launched in 2010), some studies done on iPad use in schools have shown that it is a promising tool for the classroom (Siegle, 2013; Osmon, 2011). It is highly portable and allows for a new form of "play" (Plowman & Stephen, 2008). Plowman and Stephen (2008) also highlight that the touchscreen surface of an iPad allows for physical manipulation addresses the critique of computers being detrimental to a child's development due to its "fixed, screen-based nature".

However, creating a developmentally appropriate technological tool like the ScratchJr iPad app only addresses part of the experience that creates opportunities for children to learn. Teachers play a strong role in helping children use technology in their learning. Thus it is important to look at how teachers in a public school use a technological program such as the ScratchJr iPad app in their classes.

This thesis will look at how different teaching styles using the ScratchJr affect student learning in a kindergarten classroom. Through an examination of how different teaching practices impact student learning, I hope to identify the barriers for technological integration of tablet computers in kindergarten classrooms. These findings will provide us with information on ways to support teachers in their use of a technological tool like ScratchJr.

Chapter 2: Literature Review

The Technological Debate

With the growing emphasis that is placed on technology in everyday lives, it is no surprise that many have looked into the impact technology has on the development of a young child. There is currently a debate on whether an emphasis on technology such as using computers and touchscreen devices is appropriate for young children. The idea of introducing technology to young children has been met with both "support" (Shade & Watson, 1990) and "concern" (Elkind, 1996). In an article published in the *Alliance for Childhood*, Cordes & Miller (2000) make a call to stop the use of computers in early childhood education. Healy (1998) was also of the opinion that processes for brain development in early childhood can be hindered by computer use, and argued that due to the sensitive period of a child's brain development the use of digital media during this time should be purposeful and "carefully planned" (Healy, 1998). Many of these concerns stem from the belief that computer use in preschool will impede a child's social development, opportunities for learning and lead to a reduced number of developmentally appropriate play activities (Barnes & Hill, 1983; Kaden, 1990; Zajonc, 1994).

In addition, according to the American Academy of Pediatrics, using media excessively can lead to children having "attention problems, school difficulties, sleep and eating disorders and obesity". Thus, the AAP has recommended that screen time for children be limited to less than two hours per day.

Computer Programming

Amidst the debate, one should note that there are many ways which computers can be used in early childhood education. Clements and Gullo (1984) discuss the differences between Computer Assisted Instruction (CAI) and computer programming. CAI programs consist of pre-programmed activities for children. These take the form of educational software and games that teachers can use to teach in class. Computer programming, on the other hand, provides children the opportunity to learn by "teaching" the computer what to do. In their comparison of CAI and computer programming, Clements and Gullo (1984) looked at the effects technological tools had on children's metacognitive ability, cognitive style and cognitive development. Results show that children exposed to computer programming scored significantly higher on various measures of "operational competence (classification and seriation)" and "metacognitive skills (problem solving)" (Clements & Gullo, 1984, p. 1055). Computer programming allows children the opportunity to be part of a problem solving process that allows them to "clarify their thoughts and receive immediate feedback" (Fessakis, Gouli & Mavroudi, 2013, p. 87).

Research on Logo, a text-based programming software, has shown that programming can help young children learn cognitive skills and improve in their linguistic ability and number literacy (Flannery et al., 2013; Clements, 1999). In a study, Bain & Ross (1999) found integrating technology in classrooms led to a significant increase in standardized test scores. In a study, Sivin-Kachala & Bialo (2000) found that the use of technology in classrooms led to an increase in student motivation and led students to evaluate themselves more positively.

Technological Integration

Over the past decade, a growing emphasis has been placed on using technology in educational settings. Keengwe (2007) notes that technological integration in classrooms has garnered interest from stakeholders such as policymakers, school administrators and parents. There has been a great deal of public and political support for this initiative (Cuban, 2001; Oppenheimer, 2003). In February 2014, President Barack Obama announced a $3 billion investment in education technology made by the Federal Communications Commission and private technology companies with the aim of closing the technology gap in schools, allowing all students equal opportunities to technology in schools.

At the same time, Keengwe and Onchwari (2009) also made the distinction between "technology use" and "technology integration". They highlighted the need to motivate and train teachers so that they have the skills they need in order to integrate technology in classrooms. Rather than using technology for one component of the day, they recommend allowing technology to pervade all aspects of the classroom.

However, in tandem with the push for technological integration, there exist barriers.

Scholars have defined technological integration in different ways. Technological integration can be understood in terms of how teachers use computers in classrooms – ranging from students doing internet searches or creating multimedia presentations to analyzing data required for projects (Cuban, Kirkpatrick & Peck, 2001). From the perspective of teaching and instructional purposes, Hew and Bush (2006) view technological integration as the use of computing devices for instructional purposes, and Ertmer (2010) considers technological integration as making technology a meaningful tool for teaching.

There is also a growing body of research that has been conducted on how technology can be used in schools. Bebell, Russell & O'Dwyer (2004) studied technology use across 1279 classroom in Massachusetts and found that defining technological integration requires an understanding of the context in which teachers and students are using it. Thus we see that technology is as a tool lies in the hands of teachers who have the power to wield it so as to increase productivity in the classroom, elucidate ideas and concepts, and enrich the overall learning process.

Barriers to Technological Integration

"Effective teaching requires effective technology use" (Ertmer & Leftwich, 2010, p. 256). In order to understand how teachers can integrate technology effectively, we will examine the literature on barriers to the integration of technology in schools. Research on this topic has mainly focused on technological integration in elementary and middle schools. Chen (2008) focused on teacher pedagogical beliefs as a key factor affecting technological integration in schools elementary and middle grade schools. The study conducted in Taiwan showed that teacher pedagogical beliefs, identified through survey questions, did not align with teaching practices. The reasons for these inconsistencies are predominantly due to external factors such as inadequate technical and administrative support as well as class sizes being too large to support individual student learning. Chen (2008) also noted that the pressure placed on a "high-stakes" examination, which teachers needed to prepare students for made it hard for technological integration to take place

Similar findings to those of Chen's study are seen in Hew and Brush's meta-analysis of 48 studies of barriers to technological integration (2006). In their study, reasons for barriers to technological integration were classified into six main categories: 1) lack of access to resources, 2) lack of appropriate skills and knowledge, 3) institutional factors, 4) beliefs and attitudes, 5) issues with assessment and 6) subject culture. The relationships among these categories were also analyzed and the authors found a direct link between technology integration and teacher attitude and beliefs, knowledge and skills, institutional factors and resources. Subject culture and assessment had a less direct influence on technological integration due to the fact that different departments operate independently and the forms of assessment could affect how technology is be used (Hew and Brush, 2006).

In order to address these barriers, Ertmer, Ottenbreit-Leftwich and York (2006) studied teachers who used technology in "exemplary ways" in order to draw conclusions on overcoming barriers to technological integration. "Exemplary teachers" from the Midwest who had won one of five technology educator awards were asked to complete an anonymous online survey regarding their beliefs, perceptions and experiences regarding the use of technology in classrooms. Ertmer et al. (2006) found that "intrinsic factors" such as confidence, commitment, inner drive, and personal beliefs influenced teacher effectiveness compared to extrinsic factors such as technology support, time and administration.

Another key aspect in overcoming barriers to technological integration could lie in "teacher change" in beliefs, content knowledge, pedagogical knowledge of instructional practices and thinking of alternative resources for teaching. According to Fullan and Stiegelbauer (1991), some degree of change is required when teachers are asked to use technology in their classrooms. In response to these changes that need to occur, Ertmer and Leftwich (2010) discuss how schools can support teacher efforts in the process of change.

However, while much of the literature surrounding barriers to technological integration in schools has focused on elementary and middle schools, there has been little research conducted on the barriers of technological integration in early childhood classrooms. Part of the reason could be due to the mindsets regarding the use of technology with preschool children as mentioned in at the start of this chapter.

In particular, Wood, Specht, Willoughby and Mueller (2008) note that it is important to study barriers to technological integration specific to the early childhood education context because it has “features that make it distinct from higher-grade contexts”. Wood et al. used focus groups and survey methods to understand perceptions of early childhood educators regarding the integration of computer technology in schools. In their findings, they found that teachers perceived computers as not being developmentally appropriate for young children. This is somewhat true as some children lack fine motor skills necessary to use the computer. They also highlight limited resources, high demands placed on teachers and feelings of inadequacy with regards to technological knowledge as reasons for resistance to technological integration.

Shamburg (2004) looked at four themes concerning barriers to technological integration in preschools. First, Shamburg examined the complex curricular demands on early childhood educators where technology use in classes can end up being goal driven. He reported that the goal driven, results-oriented pressure led teachers to feel restricted in how they used technology in class and prevented them from exploring the computer program adequately. Secondly, there is the theme of "adaptation" due to a lack of resources. Teachers have to be creative in the way they use the Internet and shared computers. Thirdly, professional development requests were made by teachers who experienced inadequacies in the training they had. Lastly, many kindergarten and preschool teachers felt that computers in the class put a greater strain on the teacher due to the need for classroom management (Shamburg, 2004).

However, existing literature examining the barriers to integrating technology in early childhoods has dealt mainly with the use of computers in classroom. The introduction of the iPad has revolutionized the way we use and think about technology in classrooms. Plowman and Stephen (2008) highlight that the touchscreen surface of an iPad allows for physical manipulation, which addresses the critique of computers being detrimental to a child's development due to its "fixed, screen-based nature". The iPad also allows for a new form of "play" that encourages creative and collaborative play by engaging a child's sense (Plowman & Stephen, 2008). The cost-effectiveness, portability and touchscreen surface of the iPad has great potential in helping overcome existing barriers to technological integration.

Teaching Practices in Classrooms

Along with examining the barriers to technological integration in classrooms, it is also helpful to understand the considerations that teachers have to make when conducting a class. This enables us to consider how existing classroom processes can positively affect the integration of technology.

In a study discussing the considerations for curriculum design when implementing new technologies in classrooms, Boschman, McKenney & Voogt (2014) highlight that teachers often have to take into account practical considerations, such as ensuring that there is enough time to deliver the lesson, how students are seated, and the space available for the lesson (de Kock, Sleegers & Voeten, 2005). Other considerations that teachers have to make include thinking about ways to present subject matter so that it would be relevant (Handelzalts, 2009), and how students would understand the activity (Deketelaere and Kelchtermans, 1996).

An early childhood education classrooms assessment such as CLASS: The Classroom Assessment Scoring System (Pianta, La Paro, & Hamre, 2005) is designed to assess the "quality of teachers' educational, instructional practices and classroom processes". The measure examines at how teachers organize the classroom, provide instructional, and emotional support. Existing literature shows that classrooms with effective classroom management and higher quality teacher-child interactions had better outcomes for students, not only in academically, but also more being more actively engaged in class, exhibiting more well-managed behaviors and being more prosocial (Jeon, Buettner & Hur, 2014; Mashburn et al., 2008; Rimm-Kaufman et al., 2009). Research also suggests that there is a positive relationship between effective classroom management and student achievement gains (Kunter, Baumert & Koller, 2007; Walberg & Paik, 2000; Doyle, 1986). According to Brophy (1999a), "Effective classroom managers thus provide for a smooth flow of classroom activities and ensure that their students are actively engaged in learning".

Thus, existing classroom practices can support technological integration. In a study that looked at technology and education change, Means (2010) conducted a study in 14 elementary schools that implemented math and science software in classrooms and measured achievement gains in students across the schools. They found that classroom management - the need to improve classroom routine when using technology, led to higher achievement gains. They also found that effective classroom management allows teachers to focus on teaching the software rather than on the "logistics" of the new technology.

Ways of Assessing Student Learning

Along with the push by to integrate technology in classroom (Cuban, 2001; Oppenheimer, 2003), there needs to be new ways of thinking about how students are learning with technology (Resnick 2002). Resnick (2002) calls for the need conceptualize new ways of assessing learning when using technology, and for teachers to recognize that learning is as an active process for students and that teachers serve as "consultants" in the learning process (Resnick, 2002, p. 36). Roschelle, Pea, Hoadley, Gordin and Means (2000) highlight that cognitive research has shown that children learn best through "1) active engagement, 2) participation in groups, 3) frequent interaction and feedback and 4) connections to real world contexts." (Roschelle et al., 2000, P. 76).

A technological tool like ScratchJr is designed not only to enable children to learn programming skills, but to support constructivist inquiry styles. Teachers pay an important role in enabling the constructive inquiry process to take place. However, we know that the complex demands in early childhood can create barriers for effective technological use. Thus, it is important to examine how teachers use Scratch in classrooms, and investigate how teaching styles can affect the way students learn.

Chapter 3: Research Design

Background

The DevTech Research group has collaborated with the Arthur D. Healey School (Healey School) located in Somerville, Massachusetts since 2012. The Healey School a K-9 public school, which is racially diverse and serves families that are low SES. 66% of students classified as "low-income"[1] and 44% who do not use English as their first language. The school has three kindergarten classes and each class has at least an additional paraprofessional or teaching aide, as mandated by Massachusetts law. In Fall 2012, DevTech researchers taught ScratchJr (as a program on laptop computers) in kindergarten classrooms at the school. Teachers in the kindergarten classes were present to help facilitate these sessions.

In Fall 2013, the DevTech Research Group once again collaborated with the Healey School, this time using the ScratchJr iPad app. This study was conducted to see how kindergarten teachers would teach using ScratchJr in their classes. The lead teachers who participated in the study had experience with ScratchJr in the classroom when DevTech researchers taught ScratchJr to kindergarten students at the school in 2012. Although they did not actively teach the program, they facilitated by helping out in the classroom and provided support to the researcher teaching the ScratchJr curriculum. Thus, during the Fall 2013 research study, there was no formal training conducted for teachers. DevTech researchers provided teachers with iPads, and observed how the teachers taught classes using ScratchJr.

Between them, the three kindergarten teachers have a wide range of teaching experience, ranging from fifteen years to one year. Each kindergarten class has approximately 10-15 students. Participants include teachers and students of the kindergarten classes. Consent to participate in this the study was obtained from teachers and parents of students prior to the start of data collection. The study is approved by the Institutional Review Board (IRB) at Tufts University (Protocol number: 1105019).

All the three kindergarten classrooms at the Healey School participated in the study.

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1 http://profiles.doe.mass.edu/reportcard/rc.aspx?linkid=37&orgcode=02740075&fycode=2012&orgtypecode=6&

Lessons at the school are one hour forty minutes, with recess and lunch breaks in between. Each classroom often meets as a big group at the start of the lesson, “circle time”, and is then divided into different “centers”. Each center consists of approximately six students and has different activities related to the lesson. For example, during math, there could be four centers: block activity, worksheets, craft activity and counting. ScratchJr became a center during Math Literacy and Free-choice lessons. A total of 10, 80-minute lessons were observed over seven weeks from November 8 to December 19 2013.

Prior to the study, researchers conducted informal, open-ended interviews with teachers to understand their thoughts on technology, and how they planned to use ScratchJr during the study. Classroom observations notes were taken during the study and researchers collected approximately 16 hours of video footage.

At the end of the study, students individually completed a “Solve-It” assessment designed to capture how well children understood the functions of different programming blocks. During the assessment, students were shown simple projects on ScratchJr with the programs hidden. They were then asked to identify blocks they thought were used in the programs. Table 1 provides details of sequence for data collection and the types of data that were collected for the study.

Table 1
Data Collection Conducted in Fall 2013

Measurements	Date	Classroom 1	Classroom 2	Classroom 3
Teacher Interviews (Transcribed)		6 Nov.	1 Nov.	7 Nov.
		Video Footage (mins)	Video Footage (mins)	Video Footage (mins)
Classroom Observation (Field Notes, Memos, Video Footage)	8 Nov.	74	46	68
Classroom Observation (Field Notes, Memos, Video Footage)	12 Nov.	58	Teacher Absent	58
Classroom Observation (Field Notes, Memos, Video Footage)	15 Nov.	Teacher Absent	Teacher Absent	66
Classroom Observation (Field Notes, Memos, Video Footage)	19 Nov.	65	62	Teacher Absent
Classroom Observation (Field Notes, Memos, Video Footage)	22 Nov.	10	12	7
Classroom Observation (Field Notes, Memos, Video Footage)	26 Nov.	7	5	2
Classroom Observation Field Notes, Memos, Video Footage	6 Dec.	Teacher Absent	43	58
Classroom Observation (Field Notes, Memos, Video Footage)	10 Dec.	32	57	49
Classroom Observation (Field Notes, Memos, Video Footage)	13 Dec.	51	43	0
Classroom Observation (Field Notes, Memos, Video Footage)	17 Dec.	30	18	17
Total Mins		327	286	325
Total Hrs		5.45	4.77	5.42
Solve It Assessment	19 Dec.			

Conducting Preliminary Data Analysis

This thesis will analyze data from the research study conducted by DevTech researchers at the Healey School in Fall 2013 (described in the Background section above). I began with a preliminary idea, based on the literature on teaching, learning, and technology use in classrooms, and analyzes the data by looking at how teachers use ScratchJr in the classrooms. I analyzed the teacher interviews, classroom observations notes and video footage using a phenomenological approach (Creswell, 2013). In a phenomenological inquiry, the investigator abstains from making suppositions, focuses on a specific topic freshly, constructs a question or problem to guide the study, and derives findings that will provide the basis for further research and reflection (Moustakas, 1994). The phenomenological approach is appropriate because I was interested in understanding the phenomenon of how teachers use ScratchJr in kindergarten classrooms.

Phenomenology is both a description and interpretation (by the researcher) of the phenomenon (Creswell, 2013; van Manen 1990). The researcher has to "mediate between different meanings" (Creswell, 2013, p. 80). Thus, it is important for the researcher to "bracket" his or her experiences in order to gain a fresh perspective of the phenomenon. The process of bracketing allowed me to be explicit about how my background could affect the interpretation of the data studied. I have attached a few of my memos in Appendix A.

By addressing my own background and relationship with the topic, I became more aware of my own suppositions and seek to bracket these personal opinions during the course of research. While I do not believe that any researcher can completely refrain from allowing personal opinion and bias to color their research, actively engaging in reflexivity has allowed me to be aware of when, and how my opinions seep into the research.

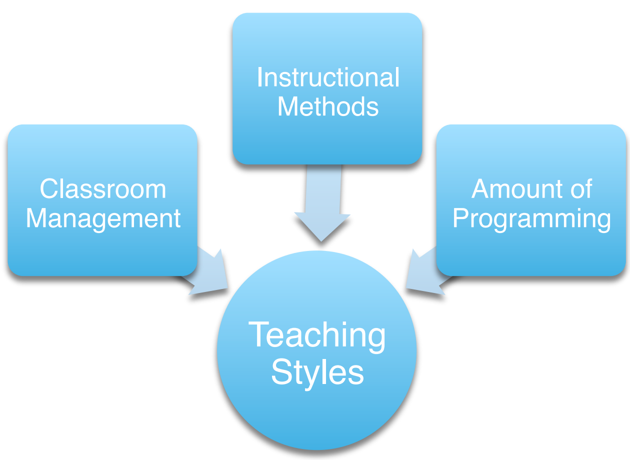
I approached the data chronologically, first watching the interviews with teachers, then reading the classroom observation notes and watching corresponding video footage taken on the day of the observation. I began the process of "reading and memoing" (Creswell, 2013, p.182), re-reading transcriptions of the interviews and summaries of classroom observation and began to create short handwritten memos along the margins of the field notes and transcripts. Doing this gave me a holistic idea of the research experience and it also added a layer of reflexivity to the process.

Core concepts from the classroom observation data emerged over the course of memoing my observations and thoughts. These were, in part guided by the literature on teaching styles and student learning, but a few sub-codes were inductive and emerged from the data.

Themes on Teaching Style

Figure 1

Dimensions of Teaching Styles observed



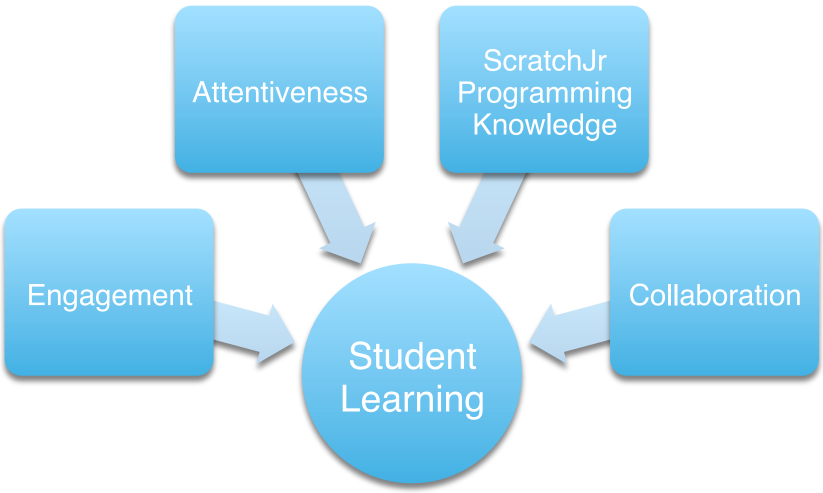
There were three main dimensions for teaching styles that emerged from the data. These were, 1) how teachers managed the classroom (classroom management), 2) how they taught the lesson (instructional methods), and 3) how much programming they did during ScratchJr (amount of programming). The dimension of classroom management and instructional methods mapped onto the CLASS (Pianta et al., 2005) classroom observation scale. The dimension, how much programming is used in classrooms, is included because I observed that teachers used ScratchJr for a range of different tasks in the classroom. The categories and subcategories are detailed in Table 2 below.

Table 2.
Teaching Styles - Dimensions and Examples

Concepts and Definition	Sub-codes	Example
Classroom Management - How teachers manage and structure the class	Setting rules	*“No walking with the iPads, iPads stay flat on the table”* *“We’re gonna all do it together”*
	Group Management	Working one-on-one Vs. Addressing the group as a whole
	Setting goals for class	“Today, we’re going to write our names in ScratchJr” *“We’re only using the blue blocks today*”
Instructional Method - How teachers provide information to students	Asking questions - Promoting inquiry	*“What do you think? Do you think red means stop?”*
	Student-led Vs Teacher Directed	Teacher-directed: Teacher taps on students’ iPads as a way of explaining something Student-led: “*What do you think?*”
	Encouraging collaboration	*“Ask Sophia how to do it. She figured it out”*
Amount of Programming in ScratchJr	• Programming use • Academic use - Math/Literacy • Learning about technology	“*We’re going to make the cat do the hokey pokey*” *“Do you want to write a story?”* Learning how to save in ScratchJr

Themes on Student Learning

Figure 2.
Dimensions of Student Learning observed



There were five dimensions identified that related to how students learn in class. Two of the dimensions overlap with Roschelle et al.'s (2000) description of the ways in which children learn when using technology, namely through active engagement (engagement), participation in groups (collaboration) and frequent interaction and feedback (engagement/collaboration). I also noticed in the classrooms that there was a difference between student attentiveness and engagement. Students could be listening attentively to the teacher (attentive), but were not interested in the task at hand (engagement). Thus I have included the dimension of attentiveness for student learning. I have also included 'ScratchJr programming knowledge" because it relates specifically to students' knowledge of ScratchJr. These dimensions are described in greater detail in Table 3.

Table 3.

Student Learning – Dimensions and Examples

Concepts and Definition	Sub-codes	Example
Engagement	• Expressing excitement about a project • Asking questions / Asking follow up questions	"I made a tadpole!"
Collaboration	• Showing each other their work • Asking each other questions • Working together on a task	"Look! I made him blue!" "How did you do that?"
Attentiveness – whether students are paying attention to what the teacher is saying	Attentive / Less Attentive	Student ignores the teacher as the teacher is explaining something.
Programming Scores	NA	Overall scores that capture how much programming in ScratchJr students understand.

Research Questions

From my preliminary analysis, I noticed that there were very clear differences in the way teachers conducted lessons. Thus, the first research question for my thesis is: **What are different teaching styles employed by teachers in the kindergarten classroom when teaching ScratchJr?**

When examining teaching styles, I decided to look at how teachers manage the classroom. For example, they may decide to set rigid rules and standards concerning behavior and use of ScratchJr, or they may allow students the flexibility explore ScratchJr without clear directives. Teachers may also choose to handle conflict differently in terms of how, and when they intervene. I looked at whether the teacher sets goals for their lessons and whether they meet those goals. Teachers also differ in the way they meet the needs of each student. Some teachers are better able to anticipate the needs of the student before he/she expresses a need. Teachers also expressed apprehension about using an expensive and fragile piece of technology like the iPad. Thus, I wanted to understand how they would make ScratchJr part of the lesson in their classes.

Understanding the different teaching styles when teaching with ScratchJr leads to my second research question: **How do different teaching styles affect how students learn when using ScratchJr?**

I utilized concepts from the literature and data collected in order to define student learning. I looked at how attentive students are in class, whether they are listening to the teacher and following the teacher's directives. I wanted to understand how engaged students are in class, whether they stay on task and are engaged by ScratchJr. I also looked at whether students collaborate with one another during the lessons with ScratchJr - do they ask each other questions, offer solutions and show each other their work? How spontaneously do they interact with one another when using ScratchJr? Finally, I used an experimental assessment developed by the DevTech Research Group, the 'Solve-It' assessments, that measure how much programming in ScratchJr students have learned.

By understanding how teaching styles affect how students learn, I hope to also better understand what are some of the barriers to technological integration, specific to using a programming tool such as ScratchJr, in kindergarten classrooms.

Hypotheses

There were three hypotheses for this thesis.

1) Using ScratchJr will lead to a range of teaching styles in classrooms.

Teachers may be uncomfortable with the use of a new tool in the classroom. This could lead to different reactions from teachers, exhibited in their teaching strategies. For example teachers who are generally comfortable managing the class may be uncomfortable with having an expensive and somewhat fragile tool like an iPad in the classroom. This could lead to teachers setting up more rules in the classroom to manage how the iPads are used.

2) The different types of teaching styles will have an impact on student learning.

The different teaching styles will impact student learning in a variety of ways. As described in the Introduction, ScratchJr was designed within Constructionist framework, allowing children opportunities to learn by interacting with the tool and constructing knowledge for themselves. A constructionist approach to teaching could mediate this form of learning.

3) There may be existing practices within the classroom that can be leveraged to support technological integration.

The findings on teaching styles and student learning may give us ideas on how we can support teachers' use of ScratchJr so that ScratchJr is better integrated into the classroom.

Chapter 4: Methodology

I re-analyzed sections of the video footage by applying the codes collected in the preliminary analysis. This time, I decided to adopt a mixed-method analysis, first collecting data quantitatively, and then triangulating it with qualitative results. In the sections below, I will explain how I chose the sample of video footage for analysis and the steps I undertook to develop a coding protocol.

Sample

I found that there was an unequal number of hours of video footage collected for the study. This could be due to the teacher being absent on occasion and the class was led by the paraprofessional who did not have consent to take part in the study. Another possible reason for the unequal video footage could be that some classrooms also had fewer interactions among teachers and students and therefore had fewer hours of video data.

In order to get a representative sample of data, I used the coding protocol for teachers and students to analyze 40 minutes of video footage across three segments of the study – the beginning, middle and end. A total of 1 hour and 50 minutes of video footage was analyzed for each class. This provided me with a more accurate picture of teaching and learning in the classrooms as teachers may have changed their teaching methods over the course of the study.

Creating a Coding Protocol

Teaching style. The coding protocol for teachers can be found in Appendix B. In order to develop a coding protocol for teaching styles, I drew from the Teaching Styles Inventory (TSI) developed by Grasha (1996) as well as the Classroom Assessment Scoring System (CLASS) developed by Pianta, La Paro, & Hamre, (2005) in order to better understand and define teaching styles. The TSI is a 40-item self-report measure that groups teacher characteristics into five teaching styles – expert, where the teacher has all the knowledge students need; formal authority, where the class is taught with clear boundaries; personal model, in which the teacher becomes a role model for the student; facilitator, where the focus is on teacher-student interaction; and delegator, where the emphasis is placed on the student being able to learn on his or her own (Grasha, 1996). The TSI has acceptable reliability and validity (α = 0.68–0.75 on individual scales, and α = 0.72 for the entire test). However, a limitation of using the TSI alone is that it places a lot of emphasis on direct instructional methods. In kindergarten, one would be just as concerned with other dimensions of teaching styles such as classroom and conflict management.

The Classroom Assessment Scoring System (Pianta, LaPara & Hamre, 2005) is an observational tool that assesses and quantifies classroom quality across three domains – emotional support, classroom organization and instructional support. There are several dimensions across these three domains that are scored on a scale of 1 to 7. The domain of emotional support includes dimensions of classroom climate, teacher sensitivity and regard for student/child perspectives. The classroom organization domain includes dimensions of behavior management, productivity and instructional learning formats. The domain of instructional support includes “concept development, quality of feedback, language modeling and literacy focus” (Pianta et al., 2005).

I combined the codes from the preliminary analysis with these measures and created a 36-item Coding Protocol for Teachers (Appendix B) that looks at teaching styles in different aspects of the classroom. The coding protocol looks at Classroom Management using questions, “Does the teacher have a clear lesson plan/ curriculum for the lesson?” - Yes/No response; “Is there conflict observed?” - Yes/No response; “If there was an explicit goal, to what extent did the teacher accomplish those goals?” - Likert score response.

The Likert scales were described in order to ensure clarity and rigor in coding. For example, for the question “To what extent did the teacher accomplish those goals”, the Likert scales responses are: 1) None or very few students are doing the task the teacher has set for them. 3) Some are doing/have done the task teacher has set out for them. 4) Most or all of the students are doing/have done the task teacher has set out for them.

When examining the methods of instruction in the class, the questions on the coding protocol include “How much active facilitation and support does the teacher provide while students are using ScratchJr?” - Likert scale response; “How does the teacher engage the students?” Qualitative response; “Does the teacher encourage collaboration?” - Yes/No response.

In examining how teachers use ScratchJr in the classrooms, questions on the coding protocol included “How is ScratchJr used during the lesson?” The Likert scale responses for the question were: 1) Teacher gets students to do programming, 2) Teacher gets students to use ScratchJr without programming, Describe.

Student learning. The coding protocol for student can be found in Appendix C. I have chosen to define student learning in a holistic manner, looking at student attentiveness, engagement and collaboration. In order to understand how attentive students were, I asked the question on the coding protocol, “How attentive were students during the ScratchJr lesson?” The Likert scale responses were: 1) Barely paying attention – most of them were doing their own thing, 3) Most of them are paying attention, 4) Almost everyone is paying close attention to what the teacher is saying. In order to assess how engaged students were in class, questions on the coding protocol include, “Do students ask questions in class?” – Yes/No response; “Do students ask follow up questions?” – Yes/No response. In order to understand how much students were collaborating, the questions on the coding protocol include, “Do students collaborate spontaneously in class?" – Yes/No response; "If 'collaboration is observed, what is the level of collaboration observed?" The Likert scale responses: 1) One or two students collaborating, 3) Moderate collaboration: about half the table is shows some form of collaboration at any point in time, 4) A lot of collaboration: almost all the students at the table collaborate at some point during the lesson.

"**Solve-It" assessment rubric.** DevTech designed a series of assessments, "Solve Its", meant to assess how much students' knowledge of ScratchJr. In the assessments, researchers were interested to test block recognition - whether students understood the different functions of the blocks in ScratchJr.

At the Healey School, the researcher conducted assessments on the last day of the study (19 Dec.) and the teacher facilitated the assessment process. Students were first given a sheet of paper with the pictures of the blocks used in ScratchJr. Holding up an iPad, the researcher shows a program in ScratchJr and students circle the blocks they think were used in the program. Students each completed three Solve-It questions.

Scoring. Appendix D shows an example of scoring the Solve It assessment. The assessments were scored using an answer rubric created by the DevTech Research Group. One point is added when a block is incorrectly identified or when a block is missing. A perfect score (0) is when the student is able to correctly identify all the blocks used in the program.

Interrater agreement. Two student researchers from DevTech were trained to use the coding protocol through a two-part process. First, the protocol was explained in detail to both researchers. Next, the researchers individually coded 15-minute segments of video footage and coding scores were be assessed. During this time, there were a few disagreements that arose with regard to the coding scheme. For example, we needed to clarify what was considered "teaching" during lessons with ScratchJr - whether a teacher explaining the rules was considered teaching, or if teaching only took place once the teacher began talking about ScratchJr. Coding issues were resolved as a team and the coding protocol was revised.

Chapter 5: Analysis

Teaching Styles and Student learning

The coding protocol for teaching styles and student learning were used to code 40-minute video segments from each stage of the study, for each classroom. The values derived from Likert scale ratings for the different dimensions of teaching styles include, 1) how teachers manage the classroom, 2) how teachers facilitate and teach new concepts in class, 3) how teachers handle conflict among students; 4) how productive they are in the classroom, and 5) how they introduce new concepts. The quantitative results on different dimensions of student learning provided scores for student attentiveness, engagement and collaboration.

The quantitative results on the coding protocol were computed in SPSS and analyzed for descriptive statistics of mean scores and standard deviations in the different dimensions of teaching and student learning. This gave us an idea of variability in the teaching styles and student learning outcomes during lessons with ScratchJr. It is important to note that due to a small sample size of three classrooms, the statistical scores were interpreted cautiously.

The quantitative findings will be triangulated with the qualitative data collected on the coding protocol which were used to validate the findings (Creswell, 2007). The method of triangulation involves corroborating data from different data points in the study, in order to strengthen or confirm the quantitative results (Creswell, 2007).

Overall Classroom Solve-It Score

The Solve-It Assessments for students in all the classrooms (n=38) were scored as described in the "Methodology" section above. The scores for each question were then added and a mean score for the class was calculated. The overall scores were added to the student learning scores to get a total student learning score.

Teaching Styles and Student Learning

I used a Pearson's correlation analysis to see if there were any significant correlations between teaching styles and student learning in classrooms. This provides and indication of whether there were specific teaching practices related to the way students engage, learn and collaborate during ScratchJr. Due to a very small sample size of three classrooms, the correlation statistics were interpreted cautiously.

Chapter 6: Results

Types of Teaching Styles in Classroom

This section will present the results of different dimensions of teaching styles for the three classrooms. The results are derived from the coding protocol examining the different dimensions of teaching styles.

Classroom management during lessons ScratchJr. Emmer & Stough (2001) define classroom management at "actions taken by a teacher to establish order, engage students, or elicit cooperation". This section looks at different areas of classroom management in the classrooms – whether a lesson plan is used with an explicit goal in class, how order is established and maintained through rules in class, how conflict between students are prevented and resolved, how involved teachers are during the lesson, and how they choose to work within the centers.

The table below shows the scores from the coding protocol that corresponds to dimensions of classroom management. In the data shown, higher numbers correspond to a higher degree of classroom management enforced. For example, a higher score on “Lesson Plan”, where 1=No (lesson plan), 2= Yes”, Classroom 2 had the highest mean score (1.67), indicating that the teacher had a lesson plan in most of the observations. For items scored on the Likert scale, e.g. “Intervention to ensure student is following lesson plan”, a larger number indicates that teachers intervened most of time when students did not follow their plan for the lesson.

Table 4.
Mean Scores for Dimensions of Classroom Management

	Classroom 1	**Classroom 2**	**Classroom 3**
Lesson Plan (N=1, Y=2)	1.33 (SD=.577)	1.67 (SD=.577)	1.33 (SD=.577)
Explicit Goal for Lesson (N=1, Y=2)	1.33 (SD=.577)	1.67 (SD=.577)	1.33 (SD=.577)
Intervention to ensure student follows lesson plan (Likert Scale: 1-4)	2 (SD=1.41)	4 (SD=.00)	4 (SD=.00)
Achieve Goals (Likert Scale: 1-4)	2 (SD=.00)	3 (SD=.00)	4 (SD=.00)
Level of Facilitation (Likert Scale: 1-4)	2 (SD=.00)	3.67 (SD=5.77)	4 (SD=.00)
Teacher Sensitivity (Likert Scale: 1-4)	3.67 (SD=.577)	3 (SD=1.00)	2.67 (SD=.577)
Total Class Management	**12.33**	**17.01**	**17.03**
	Low Structure	**High Structure**	**High Structure**

The results indicate that there is a continuum (Figure 3) for classroom management, ranging from high to low structure classrooms.

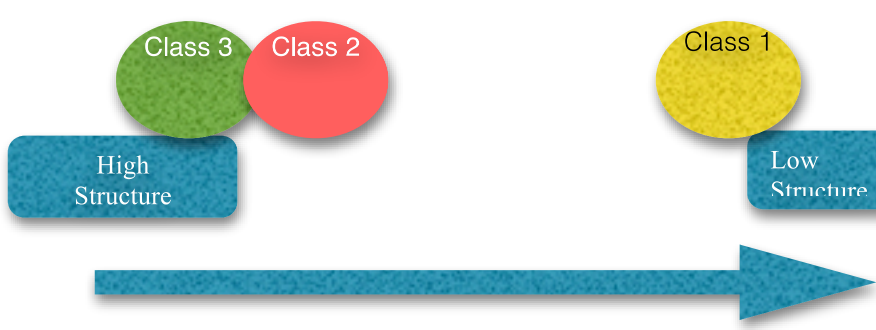


Figure 3.
Classroom Management Continuum

Table 5.
Characteristics of High and Low Structure Classrooms

	High Structure	Low Structure
Lesson Plan	Teacher shows that she has a plan for the lesson. This is different from having an explicit goal in that having an explicit goal implies a desired end result. E.g. "*Write your name in ScratchJr and count the number of letters in your name*"	No lesson plan, students do a range of different activities during ScratchJr.
Explicit Goal for Lesson	Teacher expresses a desired end result for the lesson. "*We're doing the Hokey Pokey today"*	Teacher describes the lesson as "exploratory" Students do a range of different activities during ScratchJr.
Intervention to ensure student follows lesson plan	The teacher stops students from deviating from the task. She either stops them from doing something else, "*Turn off the recording, we're not gonna record right now*," or may make staying on-task a condition for staying in the center with iPads, *"We're just working on the blue blocks today so you can either do the challenge or something else*."	Teacher may express a goal at the start of class but does not follow through with the instructions when she observes a student doing something else. She may ignore the student or go along with whatever the student is doing.
Achieve Goals	Most, if not all of the students end up doing what the teacher sets out for them to do. They would be allowed to do whatever they want with ScratchJr once they have accomplished what has been set out for them to do.	Students do not end up doing the task that the teacher sets out for them. They get distracted with other functions in ScratchJr.
Level of Facilitation	The teacher is physically present in the center with ScratchJr most, or throughout the lesson. She asks questions and engages students either one-on-one or as a group.	The teacher may be physically present at the center with ScratchJr, but is distracted by things going on in the class. The teacher may also be absent for most of the time, walking around the classroom and occasionally checking in on students.
Teacher Sensitivity	In a highly structured class, the teacher is sensitive to the needs of the student, often able to anticipate them before the student has a chance to articulate a need. This also appeared to help prevent conflict between	The teacher is less aware of the student's needs. The student sometimes needs to request for assistance multiple times before

	students.	the teacher responds.

Other themes from teacher interviews and classroom observations that related to the concept of classroom management are discussed below. These descriptions add to our understanding of why teachers many have chosen to manage their classes the way they chose to do so.

Implementation of rules in the classroom. Before the start of the study, interviews with the teachers reflect that they were worried about the fragility of the iPads in the classrooms.

"…it's an expensive device so I'm nervous about them (students) using it so that they're stationary and don't fall" *-Teacher, Classroom 2*

This anxiety translated to the way teachers set up rules regarding how the iPads are used during lessons with ScratchJr. However, the way teachers establish rules differed the most between classroom 1 and Classroom 3.

In Classroom 1, the rules are explicitly explained to the whole class as a big group. These rules extend to both behavior of students, "no walking while holding the iPad" and "no walking to the iPad table when it's not your turn"; as well as related to the use of the iPads, "lightly tap the buttons", "we're only going to use ScratchJr". Teacher 1 also models the appropriate behavior for the iPad use by sitting up straight in a chair and showing students how to tap the screen of the iPad. She also reinforces the rules by asking students to repeat them to her.

In Classroom 3, rules are less explicit and are woven into the lesson as students begin using the iPad in centers. For example, the teacher reminds students that they need to be "sitting and showing me that you're respectful". As the lesson progresses, she notices that a student has a corner of the iPad not on the table. She then reminds him, "Remember, the iPad stays on the table”. The teacher also reminds individual students of the rules to students individually rather than address the entire group. For example, when a student lifts the iPad up, the teacher tells him to “keep it on the table”.

It is interesting that although Classroom 1 had a low structure, the rules were explicit and detailed. In contrast, Classroom 3 had a high structure, but the rules are less explicit and served as reminders on occasion. This adds to our understanding that a highly managed class-room does not need to have explicit rules laid out during class. In fact, this gives us cause to re-consider what it means to have a high structured classroom. Perhaps highly structured class-rooms operate have systems in place that enable students to adhere to rules without the need to be explicit about them.

Group management. Within the centers with ScratchJr, teachers exhibit different ways of working with students. First, I noticed that teachers chose to work with different numbers of students when ScratchJr was used in class. Classrooms 1 and 2 had consistently lower numbers in the ScratchJr centers (an average of two to three students at each iPad center) and Classroom 3 had an average of about 5 students.

Table 6.

Number of students and Teacher’s Interaction Style

	Classroom 1	Classroom 2	Classroom 3
Number of students in the ScratchJr Center	2.67	2.67	5.33
Way of interacting with Students	One-On-One	One-On-One	Group Teaching

Teachers in Classroom 1 and 2 preferred to work with students one-on-one, addressing them directly and teaching them new functions in ScratchJr individually. While they do so, the other students in the center are either working on their own or collaborating with other students.

The teacher in Classroom 3 worked with the group, often preferring to spend most of the time in the ScratchJr center teaching the group collectively. This is seen in the way she addresses students as a group, “Does anyone know what the numbers below the blocks mean?” This method of teaching allows the responses from individual children to guide the discussion within the group. This appears to create a more student-led learning environment. It also encourages collaboration amongst the group as students contribute their ideas and the teacher mediates and facilitates the different responses.

Figure 4.
Teacher Working One-on-One Vs Working in a Group

Management of conflict. In order to identify conflict in class, I looked for situations where disagreements arose between students that required intervention from the teacher. Across all classrooms, there was actually very little conflict among students during sessions with ScratchJr. This could be due to the fact that teachers provided each student with an iPad, therefore, students were not required to share, minimizing potential sources of conflict. The only time conflict was observed was in Classroom 2. One student took another student's midway through the lesson with ScratchJr. The teacher noticed the student's distress and intervened by teaching them to resolve the matter.

Types of Instructional Methods in Classrooms

This section looks at different ways that teachers instruct during ScratchJr. The codes in the coding protocol related to this dimension of teaching are whether or not they use an iPad themselves while teaching, whether they transmitted knowledge through teacher-directed or student-led ways and whether they encouraged collaboration.

The table below shows the scores from the coding protocol that corresponds to dimensions of instructional methods. In the data shown, higher numbers on the scores indicates that the teacher has adopted a more student-led approach in her method of instruction. Lower scores indicate a more teacher-directed approach. For example, a higher score on "Direct Instruction Vs. Mediation", indicates that the teacher asked more questions to facilitate learning and encouraged students to ask each other for help. A lower score could indicate that the teacher preferred to tell students the answer or move programming blocks for them in response to questions they had.

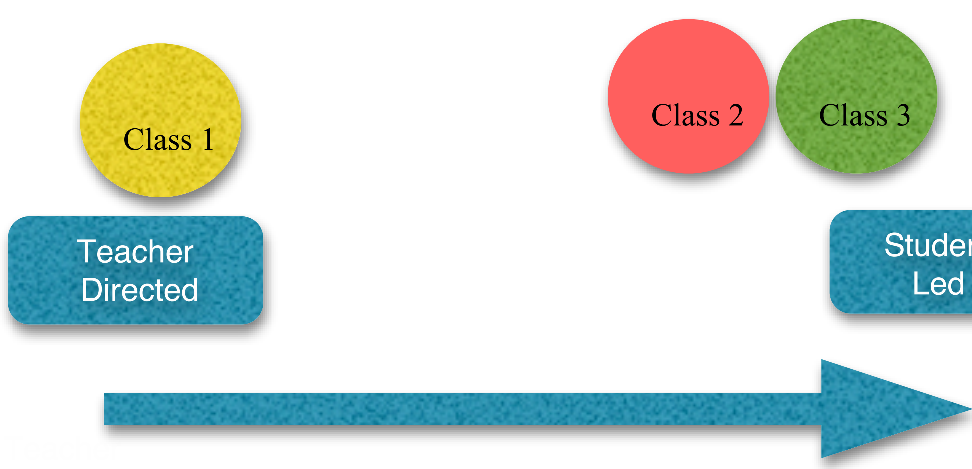
Table 7.
Mean Scores for Dimensions of Instructional Methods

	Classroom 1	Classroom 2	Classroom 3
Teacher use of iPads (N=1, Y=2)	1.33 (SD=.577)	1 (SD=.00)	1.67 (.577)
Direct Instruction Vs Mediation 4= Ask Someone else 3=Ask questions 2=Intsruction /Tells ans 1=Doing it for students	1.72 (SD=.25)	2.03 (SD=.87)	3.25 (SD=.25)
Encourage Collaboration (N=1, Y=2)	1 (SD=.00)	1.67 (SD=.577)	2 (SD=.00)
Total Instructional Score	**4.05**	**7.89**	**8.87**
Instructional Method Continuum	**Teacher-Directed**	**Student-Led**	**Student-Led**

The results show that there is a continuum for Instructional Methods, ranging from teacher directed to student-led learning styles. Figure 5 shows where each classroom lies on the continuum. Table 8 describes the characteristics of classrooms that are student-led and teacher-directed.

Figure 5.

Instructional Methods Continuum



Instructional Methods Continuum

Table 8.
Characteristics of Teacher-Directed and Student-Led Classrooms

	Teacher-Directed	Student-Led
Teacher's Use of iPad	The teacher does not use an iPad during lessons with ScratchJr. Although this may appear to be a way for her to engage more fully with students, the teacher is less able to share in the experience as a co-learner and remains in the role of an instructor.	The teacher uses an iPad during lesson as she is teaching. This leads to a more facilitative style of teaching where the teacher's role shifts from instructor to "co-investigator". At the start of the lesson, the teacher usually asks students questions what they're doing, as a way of checking on their progress. However, the teacher then asks about the program and the student's role shifts to instructor. The shifts occur seamlessly during the lesson.
Direct Instruction Vs Mediation	The teacher will often answer questions by telling the student the answer, or moving blocks in ScratchJr for the student.	The teacher functions as a facilitator and refrains from directly answering questions. She prefers to ask the group for an answer, "*Does anyone know how to make the cat jump*?". She also directs students to ask each other questions, preferring for them to teacher each other.
Encouraging Collaboration	The teacher does not explicitly encourage collaboration. In some instances, students may collaborate when the teacher leaves the group. This could indicate that the students rely to a greater degree on the teacher for answers.	The teacher explicitly encourages collaboration, "Use your words to tell him how."

Ways of Asking Questions. The theme of how a teacher asks questions in class emerged from classroom observation notes and videos. Although the quantitative data on the coding protocol reflects that teachers who are ask more questions have a more student-led approach to teacher, the qualitative data shows variation in the types of questions teacher ask and the motivations behind them. This may help us understand why teachers may prefer a particular method of instruction. These are explained in Table 9.

Table 9.

Type of Questions Teachers Ask

Types of Questions	Illustrative Quote
Asking questions to find out what students know/don't know (scaffold)	*"What do you think, do you think red means stop?"*
Asking questions to get students to do something	*"Can you sit on your bottom?"* *"I'd like for you to listen right now"*
Asking questions to get students find out what students are doing.	*"Is that a pirate ship?"*
Asking questions to generate interest	*"Does anybody know what the orange block does?"*
Asking questions to encourage collaboration	*Wow, you're such a little investigator. Can you show John how you did that?*

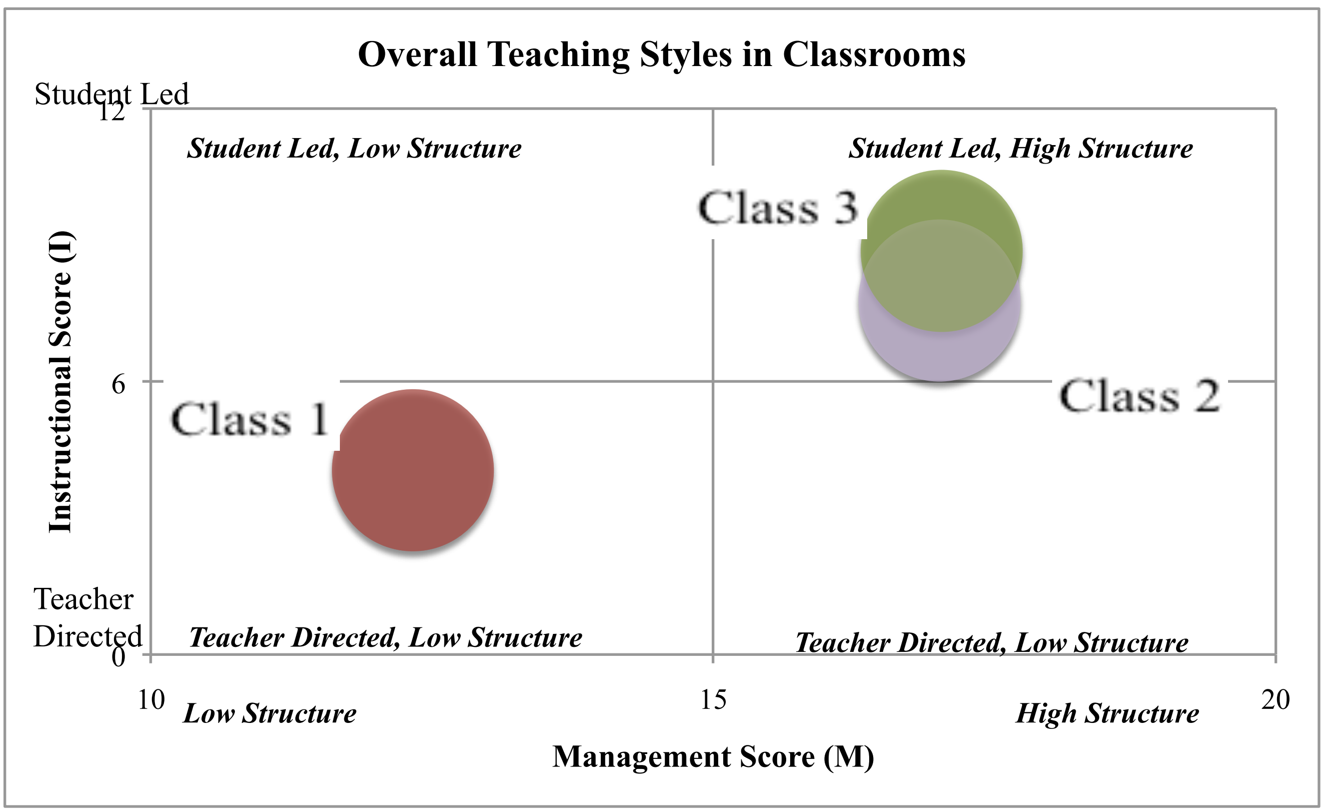
From the different types of questions observed in the classrooms, it's appears that the number and type of question asked reflects the quality of student-led instructional methods during ScratchJr. For example, teachers may ask questions to get students to something. However, these types of questions are different from the questions that scaffold students' learning, "What do you think…do you think red means stop?"

The classroom observations show that all three classrooms ask questions to generate interest. However, Classroom 3 asked questions that relate to encouraging collaboration. Both classroom 2 and 3 asked questions to understand how much students understood in ScratchJr in order to introduce a new concept. Classrooms 1 and 2 often asked questions that had a directive, or were trying to find out what students are doing as a means of checking on them.

Classroom Management and Instructional Methods

I created a chart using the total values of classroom management and instructional methods to display where the three classrooms lie on both the continuums for classroom management and instructional methods. In the chart below, the X-axis represents the values of classroom management, with a larger number indicating that the classroom has a high structure, and a smaller number indicating low structure. The Y-axis represents instructional methods, where a larger number indicates a more student –led approach instructional style.

Figure 6



It is interesting to note that the three classrooms fall into two categories – High Structure / Student-Led and Low Structure /Teacher-Directed. In the next section, we will look at the amount of programming that was done in each of the classrooms.

Programming use in ScratchJr

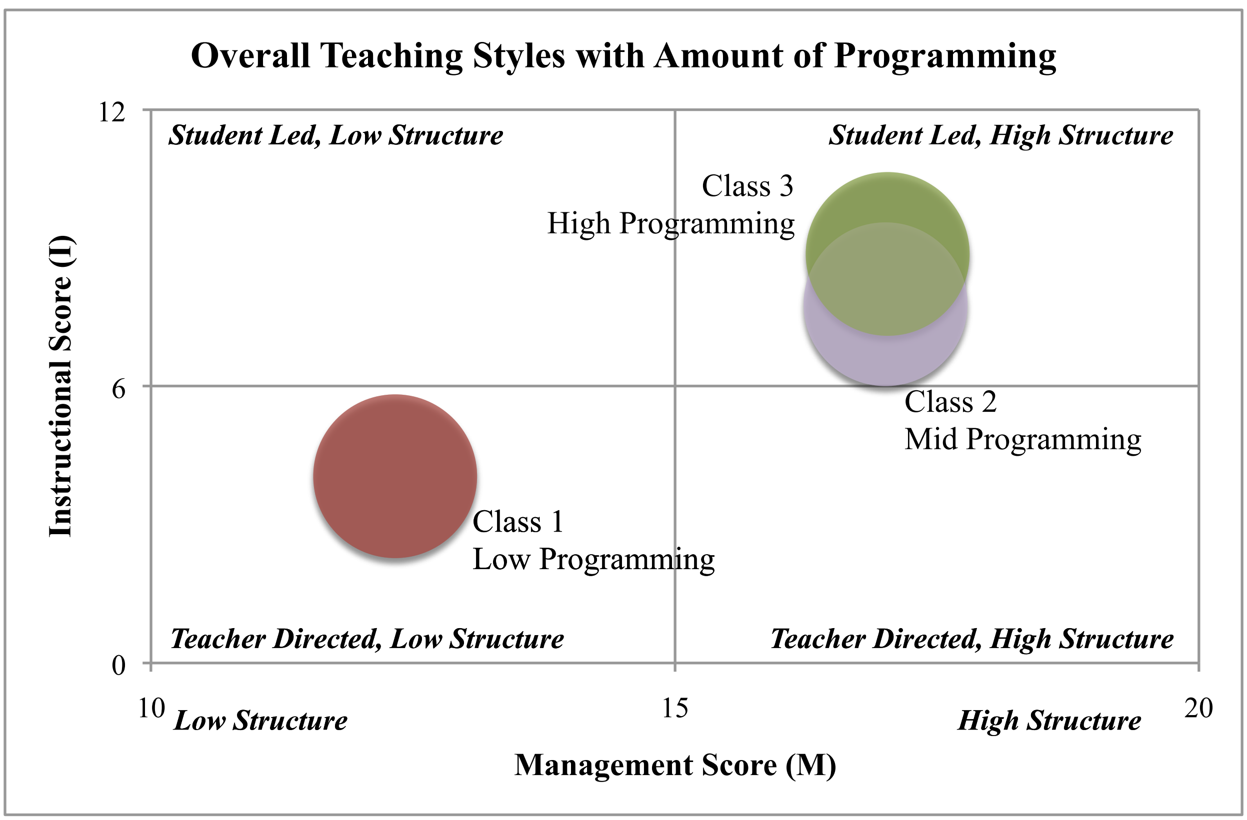
ScratchJr is a tool designed to allow children to learn how to program. In this final dimension of teaching style, I will look at how much programming teachers taught in class. The Likert scale in the coding protocol was used to understand the level of programming students did in class. This corresponds to the question on the coding protocol, "How is ScratchJr used in class?" and "Does the teacher encourage programming?" A higher score indicates a greater amount of programming done. The amount of programming done in each classroom is shown in Table 10.

Table 10
Programming Use in Classrooms

Class	Teaching Style	Amount of Programming M(SD)	Level of Programming	Primary Uses for ScratchJr
1	Low Structure/ Teacher Directed	1 (SD=.00)	Low	Exploratory, Managing behavior, Academic
2	High Structure/ Student-Led	1.67 (SD=2.08)	Mid	Exploratory, Academic, Programming Learning how to handle technology
3	High Structure/ Student-Led	2.67 (SD=2.31)	High	Exploratory, Programming Learning how to handle technology

Although ScratchJr was created as a programming tool, teachers used it in a variety of ways in the classroom. The functions within ScratchJr which allow this to take place also allow for other learning possibilities, such as learning about different settings through playing with the backgrounds feature, expressing creativity by coloring or creating a new character, or using the camera function within ScratchJr to take a photo. From the classroom observation notes and videos, I observed that teachers used ScratchJr to enhance the learning of academic subjects like literacy and math, to program. However, the introduction of a novel technological tool in the classroom also functions as way of managing student behavior (e.g. students only get to use the iPads if they "behave"), as a way of (e.g. only touch iPads with clean hands), students also sometimes use the tool without a clear purpose. Figure 7 shows the different amounts of pro-gramming observed in different classrooms.

Figure 7.



It was observed from the videos that students were more engaged in the lesson when they were discovering new functions in ScratchJr. This led them to collaborate and show each other their work. However, the functions that engaged students did not always relate to programming. It is interesting to note that students were only engaged during programming when the learning process involved a teacher or peer. Students were not engaged by the programming functions in ScratchJr if they did not understand the blocks or understand how to use the blocks. Although this observation is anecdotal, it is helpful for us to recognize the importance of a teacher or peer when teaching programming in early childhood classrooms.

Student Learning

In this section, I will examine the different dimensions of student learning - how much students collaborate, how engaged they are in class, how attentive they are, and how they fared on an assessment that tests programming knowledge (Solve-It Assessments).

Table 11.

Mean Scores for Dimensions of Student Learning

	Class 1	Class 2	Class 3
Collaboration (Likert Scale: 1-4)	0.33 (SD=.577)	2.33 (SD=.577)	4 (SD=.00)
Level of attentiveness (Likert Scale: 1-4)	2.67 (SD=1.16)	3.33 (SD=.577)	4 (SD=.00)
Level of Engagement (Likert Scale: 1-4)	2.33 (SD=1.03)	3 (SD=.577)	4 (SD=.00)
Solve-It Scores	6.33 (SD=.35)	6.36 (SD=3.18)	6.77 (SD=.55)
Total	**11.66**	**15.02**	**19.11**
Overall Student Learning	**Low**	**Mid**	**High**

The scores that corresponded to student learning were tabulated, and the mean score for each class was obtained. The score for collaboration indicates how often, and the different ways in which students collaborate. The score for attentiveness indicates whether or not students are paying attention and listening to the teacher. A high score would indicate that the student is not often distracted, able to follow the teacher's instructions, and the teacher does not have to regularly try to get the student's attention The score for Level of Engagement assesses how interested the student is when using ScratchJr. This is seen in how many questions the students asks and whether there are follow up questions. The table below describes how student learning in high and low classrooms.

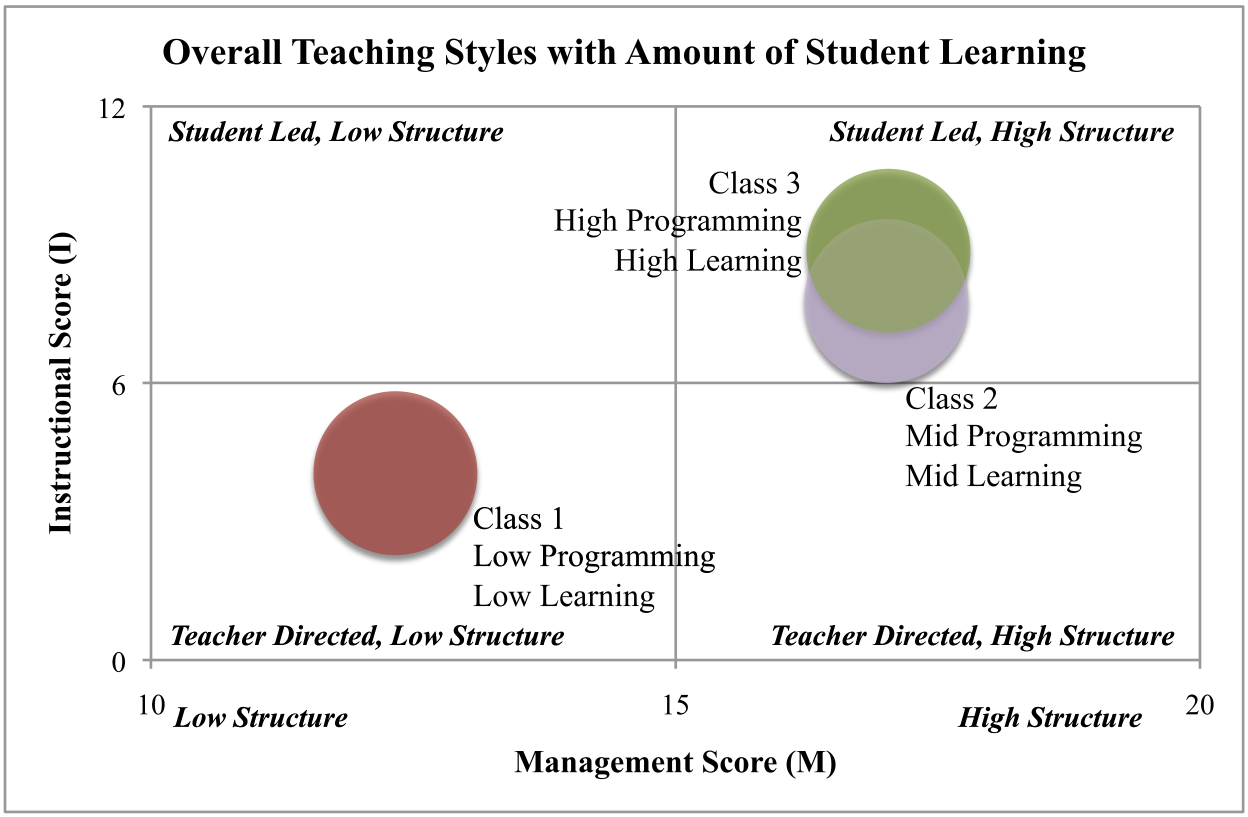
Table 12.
Characteristics of Low and High Student Learning Classrooms

	Low Student Learning	High Student Learning
Collaboration	Students rarely collaborated and worked on their own projects individually. They preferred to seek help from the teacher, rather than ask their classmates for help.	Students collaborated by asking each other questions, showing each other their work and spontaneously working together.
Level of attentiveness	Students were not listening to the teacher and the teacher often had to try to get their attention repeatedly. The students observed also appeared less focus and were distracted easily.	Students listened to the teachers' instructions and understood what the teacher was asking for. The students were able to focus more.
Level of Engagement	Students rarely asked questions during the lesson and were observed to lose interest in ScratchJr, "*I'm done.*"	Students were enthusiastic and had a variety of questions and follow up questions about the lesson or program. They also showed engagement by expressing excitement in their work. "*Look, I made him jump!*"
Solve-It Scores	Lowest mean Solve-It scores across the classrooms	Highest mean Solve-It scores across the classrooms

Teaching Styles and Student Learning

Classroom 3 has the highest level of student learning across all dimensions. It is interesting that although both Classroom 3 and Classroom 2 fell into the same categories of teaching styles, students in Classroom 3 have higher scores of student learning. Figure 8 shows how the different teaching styles in classrooms correspond to scores on student learning.

Figure 8



It is interesting to note that the classroom with highest scores of structure, student-led learning, and amount of programming, also corresponded to the highest mean learning scores in the classrooms. In order to understand how the teaching styles impact student learning, I conducted a Pearson's Correlation in SPSS to understand the relationship between overall teaching and overall student learning. The results are shown in Table 13.

Table 13

Relationship Between Teaching Styles and Student Learning

	Mean (SD)	Overall Teaching	Student Learning
Overall Teaching	24.14 (SD=5.95)	1	r=.920
Student Learning	15.26 (SD=3.73)	r=.920	1

Note: These correlations were not significant when p=.05.

The correlation results in this table should be interpreted cautiously due to a small sample size. We note that although the overall r-scores are not statistically significant, but there appears to be a strong positive relationship between overall teaching and student learning. This suggests that if we had a larger sample, we may find that highly structured, more student-led instructional approaches, and used a greater amount of programming in classrooms could have a positive impact on overall levels of student learning, seen in their engagement, attentiveness, collaboration and programming scores.

In order to find out how the individual dimensions of teaching styles impact overall student learning, I ran a correlation to test individual dimensions of teaching styles and student learning overall scores (Table 14). Similarly, these statistical findings should be interpreted cautiously due to the small sample size. In the results, we note that the amount of programming in class had a significant positive relationship (r=.998) with overall student learning. The method of instruction use had a strong positive relationship with overall learning (r=.926), although not statistically significant. Finally, classroom management had a relative strong relationship with overall learning (r=.838), although not statistically significant.

Table 14.

Correlation Between Individual Dimensions of Teaching Styles and Overall Student Learning

	Mean (SD)	Classroom Management	Method of Instruction	Amount of Prog	Overall Learning
Classroom Mgt	15.46 (SD=2.71)	1	.982	.838	.838
Method of Instruction	6.94 (SD=2.55)	.982	1	.903	.926
Amount of Prog	1.78 (SD-.84)	.806	.903	1	.998*
Overall Learning	15.26 (SD=3.73)	.838	.926	.998*	1

Note, P value = 0.05 (2-tailed) *. Correlation is significant at the 0.05 level (2-tailed).

I also ran a correlation analysis (Table 15) to see if different dimension of teaching have a relationship with individual dimensions of student learning. This provided insight into how the individual dimensions of teaching styles could impact the individual dimensions of learning.

Table 15.
Correlation Between Individual Dimensions of Teaching Styles and Student Learning

	Mean (SD)	Amount of Prog.	Classroom Mgt	Method of Instruct.	Solve It scores	Level of Collab.	Level of attentiveness	Level of engagement
Amount of Programming	1.78 (SD=.84)	1	.806	.903	.940	.986	.994	.997*
Classroom Management	15.45 (SD=2.71)	.806	1	.982	.555	.892	.866	.758
Method of Instruction	15.46 (SD=2.71)	.903	.982	1	.702	.962	.945	.868

The results show that programming had a significant positive relationship with the level of engagement when students learn (r=.997). The amount of programming in class also had strong relationships, though not significant, with overall Solve-It scores (r=.940), collaboration (r=.986) and attentiveness (r=.994).

Although the findings may be skewed by a small sample size, the results suggest that in a larger sample, the method of instruction could have a strong relationship with the level of collaboration and the level of attentiveness. This implies that student-led instructional methods can help create opportunities for collaboration and can enable students to be more attentive in class.

Classroom management had strong correlations with collaboration (r=.892) as well as attentiveness (r=.866), although the relationship is less strong in comparison to the method of instruction and amount of programming used in class.

A correlation was conducted to understand the relationship between different dimensions of student learning. Table 16 indicates that the amount of programming that students do during class could have a positive significant relationship with how engaged students are in class (r=.997). The results suggest that the level of collaboration between students could also correlate significantly (r=.998) with student attentiveness.

Table 16.

Correlation between Dimensions of Student Learning

	Mean (SD)	Level of Attentiveness	Level of Engagement
Amount of Programming	1.78 (.84)	r= .994	r = .997*
Level of Collaboration	2.22 (1.84)	r=.998*	r=.971

Note, P value = 0.05 (2-tailed) *. Correlation is significant at the 0.05 level (2-tailed).

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Chapter 7: Discussion

The results indicate that teachers employ a range of teaching styles when a technological tool like ScratchJr is used in the classrooms. I have examined how teachers teach ScratchJr using three dimensions of teaching – classroom management, instructional methods and the level of programming with ScratchJr. I have identified a continuum for classroom management, from a high structure to low structure classrooms. I have also identified a continuum for instructional methods, ranging from teacher-directed to student-led methods of instruction.

The three classrooms fell under two types of classifications –High Structure/ Student-Led, and Low Structure/ Teacher-Directed. Although the sample sizes are small, the results suggest that a highly structured classroom, combined with a student-led method of instruction, and high amounts of programming use could positively impact student learning. Correlation analyses suggest that there could be strong relationships between individual dimensions of teaching styles (amount of programming, student-led instruction methods, and classroom management) and student learning (student engagement, attentiveness, collaboration, and programming knowledge). The qualitative findings show variation within these categories and describe how teachers within the same category may choose to work differently with students (e.g. working in groups Vs. working one-one-one). The implications for these findings will be discussed in the sections below.

Implications for Teaching and Learning

Role of structure when using technology in the classroom. Effective classroom management allows the teacher to focus on teaching using the tool, rather than on the logistics of the new technology (Means, 2010). This has certainly been the case in the classrooms observed. In cases where the teacher sets clear goals for learning, the goals function as parameters for students to use the tool. These classrooms have a high facilitation score, which suggest that although parameters are in place, the teacher is actively involved in scaffolding students' learning.

Student-led instructional methods and structure in classrooms. The results suggest that students may have better learning outcomes in classroom environments that adopt a more student-led method of instruction. Although student-led classrooms may often be associated with classrooms that are flexible and open-ended, we have observed that classrooms can operate as high structured and student-led. In these cases, structure enables the teacher to focus less on the "logistics" of a new tool and on facilitating learning (Means, 2010).

There are also multiple learning trajectories and outcomes for ScratchJr. Aside from learning how to program, children can also express themselves creatively through the paint editor function, they also have opportunities to learn about animals, outer space, underwater creatures through dialogue with teachers and peers. The different learning trajectories in ScratchJr enable it to be suited for student-led teaching instruction methods, which could help foster collaboration, engagement and attentiveness in students and positively impact student learning.

In contrast, traditional academic subjects like math and literacy usually have specific goals and student outcomes. This could result in teachers adopting teacher-directed approaches in their instructional methods. It may be a worthwhile endeavor to look into ways of creating curricula in early childhood classrooms that have broader learning objectives. This would allow teachers flexibility when teaching and encourage student-led instructional methods to take place.

Role of programming in classrooms. Programming open-ended and allows students the opportunity to explore and make meaningful projects as they interact with ScratchJr. The data suggests that the amount of programming in class could have a significant relationship with overall student learning. These findings also indicate that programming use could impact how engaged students are in class, how attentive they are, and how much they collaborate, as well their overall programming scores in ScratchJr. The relationship between programming and the various dimensions of learning also map onto literature regarding the positive impact of programming on student learning (Clements & Gullo, 1984; Clements, 1999; Fessakis et al., 2013; Flannery et al. 2013).

While ScratchJr has been used in a variety of ways in the classrooms observed, from teaching academic subjects, to teaching programming, to being a reward for good behavior in class. These preliminary findings on how programming can impact student learning allow us to recommend that teachers consider ways to use ScratchJr as a programming tool in their classrooms.

Impact of iPads in classrooms. Although the data indicates that programming may have an impact on student learning by engaging students in positive ways, it is also important to recognize that the introduction of a novel technological tool in the form of an iPad may have contributed to how students were engaged in class. The classroom observation notes describe how students in all the classrooms were excited to use an iPad in class. Many students wanted to be in the center with ScratchJr, before they even knew about what ScratchJr was. Some students were excited to use a tool that they had only heard about, but not had a chance to use; while other students were excited to be able to use a "toy" in the classroom. They asked questions about whether they could play other games and use other functions in the iPad. Teachers were also able to use iPads as an incentive for good behavior in students. These observations suggest that introducing a new tool like an iPad can engage students before they even use ScratchJr. When creating curricula for teaching with a new technological tool like ScratchJr, teachers can consider how they should harness the excitement and interest surrounding the iPad and help students learn.

The literature review also highlight how iPads are a promising tool for the classroom (Siegle, 2013; Osmon, 2011). The iPad's portability and touchscreen interface are unlike the fixed nature of computers, thus allows for a new form of play that encourages creative and collaborative interactions among students (Plowman & Stephen, 2008). While we have observed children in some classrooms collaborate actively during ScratchJr, all three classrooms used the iPads while seated at the table and students hardly moved when using iPads. Thus, the classrooms did not appear to leverage on the mobility of iPads when used in classrooms. One reason for this could be that teachers were apprehensive about the fragility of the iPads and expressed this during the interviews. There were also rules surrounding they way iPads were used in class. These rules, "no walking with the iPads", "iPads stay flat on the table" were often reiterated during the course of the lesson.

Thus, teachers have a difficult task of managing a group of five year olds who are excited to use an iPad, and being responsible for an expensive technological item. However, It is important that teachers are aware of the strengths of how an iPad can be used in class, and leverage of this when they manage and harness students' excitement.

Social and emotional development during programming activities. The literature has shown the positive effects of programming on academic success (Clements & Gullo, 1984; Fessakis, Gouli & Mavroudi, 2013). However, this thesis has also found that ScratchJr can positively impact social and emotional development. This was particularly salient when collaboration took place amongst students. Although the scores of student learning do not give us an indication of social and emotional development that takes place, we see from the qualitative data that students are excited and proud to share their work with classmates. Students who are less proficient in English and who are usually quiet begin to speak up when they have the opportunity to present their work.

Implications for Overcoming Barriers to Technological Integration in Early Childhood Classrooms

In the literature on barriers to technological integration, Shamburg (2004) highlighted that the complex curricular demands placed upon teachers in early childhood classrooms can lead to them limiting the way they use technology and from exploring a program adequately. In the same way, our data from classroom observations and interviews revealed that teachers at the Healey School faced similar curricular constraints. They were sometimes not in class because they had to attend to administrative issues; at times they were short-handed because of an absent paraprofessioal. Along with having to meet academic standards, they also had to organize teachers meetings, parent meeting and field trips.

When a new technological tool is introduced into the classroom, teachers have to come up with ways to accommodate the tool into the existing structure of their classrooms. This could be less of a challenge if a classroom had structures in place that can help with the transition. However, in classrooms that are less structured, the teacher may struggle to integrate it lesson, which would lead to lower student outcomes with the use of technology.

This thesis can encourage teachers in early childhood classrooms to consider how they create structures within their classrooms so as to promote student-led methods of instruction. This can help with the integration of technology in the classroom.

Chapter 7: Limitations and Future Direction

Small Sample Size and Statistical Issues

One of the main limitations in this study is the small sample size. Because we only have a few data points, it is difficult to draw conclusions about classroom practices and programming at large. Thus, we can only talk about what the findings means for the individual classroom practices and the students within the classrooms. The small sample sizes could have also contributed to the difficulty finding statistical significance between mean scores on dimensions of teaching and learning.

The statistical findings, particularly the correlation statistics should also be interpreted cautiously because the variables used in this thesis are mostly interval and categorical (aside from the programming assessments, which are continuous variables), they do not meet the assumptions required for running a Pearson's correlation.

The variables within the dimensions for teaching and learning are also unlikely to be equally weighted. For example, under the dimension of classroom management, the teacher having a lesson plan, and the teaching intervening to make sure that the student is following the goals set out for the lesson may not be of equal importance when measuring classroom management. Presenting an overall score without weighing the variables may have compromised the accuracy of the the score.

I hope to conduct a future study with a larger sample size. A study with a greater number of classrooms will not only be to tell us if the findings found in this study can be replicated, but also reveal if there are other combination of classroom management, instructional method and amount of programming in classrooms when using ScratchJr.

It would also be interesting to conduct a cross-cultural study observing how teaching styles in other countries and cultures differ from those in the United States. A cross-cultural comparison of teaching styles and student learning will help us understand how culturally-specific teaching practices can affect technological experiences, as well as what types of teaching styles and learning outcomes can be generalized to most classrooms around the world.

Research Bias

While efforts have been made to bracket my experiences through the process of reflexive memoing, it is impossible to completely bracket one's own experience when conducting qualitative analysis. Similarly, while efforts have also been made to establish interrater agreement in the coding protocol, the interpretation of classroom observations are subjective and therein also lies the possibility of a researcher bias in the interpretation of the data.

Refining and Validating the Coding Protocol

Future directions for this study could also involve refining the coding protocol for the purposes of classroom observations for teaching and learning with technology. Several of the questions in both protocols did not lead to conclusive outcomes and should be refined. Follow up studies using the protocol with larger samples in a variety of classrooms can help validate the coding protocol. At present, there is no classroom observation measure for technology use in early childhood classrooms. A validated measure will be helpful in improving outcomes when teaching and learning with technology.

This thesis has also created the possibility for further studies on the social and emotional development of students when learning programming. Social and emotional development is an important component of school readiness. Understanding how technology, in particular programming, can impact this aspect of development can enable us to create technological tools that can help students with emotional regulation and behavioral issues.

Chapter 8: Conclusion

Technology has become an integral part of our lives and has the potential be a powerful tool for teaching and learning. Research has shown that computer programming has a positive impact on how children learn (Clements & Gullo, 1984; Clements, 1999; Fessakis et al., 2013; Flannery et al. 2013). This has led to an increasing emphasis placed on technology use in education settings (Keengwe, 2007). Thus, there is a need to understand better how technology can be used effectively and integrated into classrooms (Ertmer & Leftwich, 2010).

The lack of research with regards to computer programming for young children has led to many questions unanswered – what are the teaching styles employed when a new technological tool is introduced into a classroom? How the teaching styles impact how students learn with a new technological too? The answers to these questions can help enable us to better support teachers when they teach with technology.

This thesis has set out to understand what teaching styles arise when teachers teach ScratchJr in kindergarten classrooms, and how teaching styles can impact student learning. Despite the limitations of a very small sample size, the preliminary results have helped us consider ways in which teaching with ScratchJr can impact student learning. Through the use of qualitative and quantitative methods, I found variations for teaching styles (in the dimensions of classroom management, instructional methods, and amount of programming used) and student learning (engagement, attentiveness, collaboration and programming knowledge) across the three classrooms. The results suggest that although ScratchJr is used in a variety of ways within the classroom, the use of programming in classrooms could lead to higher scores of student learning, particularly in terms of how engaged and attentive students were in class.

In addition, the findings suggest that when teachers adopt student-led instructional methods – guiding, facilitating and encouraging collaboration, student-learning outcomes could improve. Highly structured classrooms, where the teacher had a clear lesson plan and ensured that the students stay on task also had higher overall student outcomes in terms of student collaboration and attentiveness.

Shamburg (2004) highlighted the complex constraints teachers in early childhood education face when using technology in their classrooms. The teachers in this study also experienced constraints placed upon their time in the classroom, from organizing field trips and meet-the-parent sessions, to ensuring that students are meeting academic standards in their classrooms. I hope that the findings in this thesis will help start a dialogue between researchers and teachers on the ways ScratchJr in which can be taught in classrooms.

This will help teachers feel empowered in their roles when teaching with technology, and create classroom environments that leverage on the power of technology so that children can learn in optimal ways.

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434

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Appendix A

Memo: 11/8: Classroom 3

Reflections on classroom videos and notes

- It was interesting that the teacher spent a lot of time asking kids questions at the start of class. They spent 20 mins in the big circle. The teacher asked a lot of questions and used the word “let’s” a lot. This is pretty different for Classroom 1 where the teacher told students what to do. I noticed S teaching D. “hey look what I got”. The teacher is explicit in fostering collaborative learning “use your words to tell”. Interestingly, she has begun to teach some programming concepts, “Can you make a character move other than dragging it across the screen?”
- The teacher tells a student off during big group time, “K, right now we’re trying to be polite to L who’s trying to tell us something.”
    - She explains the reason for setting behavior standards rather than just tell the student what to do.
- The teacher was asked if she had discussed with other teachers what she planned to do for the lesson. She said they all talked about it before hand but expressed concern about using Scratchjr for math.
- Teacher challenges students both academically as well as with SJr functions, “Can you write your name? How did you change the color of the letters?”
- Teacher points out students who have an iPad at home. She says that the ELL kids who are generally not the ones who help others have ended up helping other students during Scratchjr.

Appendix B

Coding Protocol for Teachers

Date:
Class:

• Does the teacher to have a clear plan / curriculum for the lesson?	Yes / No Describe:
• How does the teacher use iPads at the start of the lesson?	• Teacher hands out iPads to students and begins teaching • Teacher does not hand out iPads to students and begins teaching 1. Teacher hands out iPads and does not teach explicitly
3. Does teacher use an iPad herself?	Yes / No If "Yes", how?
4. Does the teacher give each student an iPad?	Yes / No If "No", how many students per iPad? _______
5. How does the teacher get students' attention when introducing the lesson?	________________________________ • Teacher does not try to get students' attention

6. Do the number of students at each ScratchJr center change over the course of the lesson?	Yes / No Describe:
6. Does the teacher use other materials (whiteboard, physical blocks, writing materials etc) when teaching ScratchJr during the lesson?	Yes / No State:
7. How much active facilitation* and support does the teacher provide while students are using ScratchJr? * Active facilitation: Teacher is present and interested in what students are doing, asking questions related to the task. 1. *Teacher is absent.* 2. *Teacher is present but distracted by the events going on at other centers.* 3. *Teacher is observing but not engaging students appropriately.* 4. *Teacher is actively facilitating by observing and engaging students most of the time (e.g. asking questions, helping students with difficulty, challenging students)*	Very little 1 2 3 4 A lot Describe active facilitation:

8. How is ScratchJr used during the lesson?	• Teacher gets students to use ScratchJr to do programming • Teacher gets students to use ScratchJr without programming Describe: ______________________
9. How does the teacher engage students?	Teacher asks questions about what students are doing Teacher works one on one with students
10. Does the teacher encourage programming?	Yes / No If "Yes", how? If "No", what does she do?
11. What type of questions do students have when using ScratchJr?	o Questions related to programming o Questions related to ScratchJr but not related to programming o Questions not related to ScratchJr ______________________________ o Students have no questions

12. How does the teacher approach questions related to programming?	o None observed o Teacher ignores the problem and evades the question o Teacher asks questions to prompt student o Teacher tells student the answer o Teacher tells student to ask classmates for help o Teacher “answers” by moving blocks on student’s iPad • Teacher asks researcher for help
13. Are there programming related follow-up questions?	Yes / No: Describe:
14. How does the teacher approach questions related to other (non-programming) functions in ScratchJr?	o None observed o Teacher ignores the problem and evades the question o Teacher asks questions to prompt student o Teacher tells student the answer o Teacher tells student to ask classmates for help o Teacher “answers” by moving blocks on student’s iPad o Teacher asks researcher for help
15. Are there non-programming follow-up questions?	Yes / No Describe:

16. How comfortable is the teacher when answering a technological question? *1: Teacher appears very uncomfortable and does not seem to want to answer the question* *3: Teacher slightly nervous when faced with a question, but gets more comfort-able while answering the question.* *4: Teacher approaches the question with ease, even if he/she does not know the answer.*	Very little 1 2 3 4 A lot Describe:
17. How does the teacher approach non technology related problems in the cen-ter?	Type of problem: Intervention:
18. How would you describe the teacher's state of mind when she's at the ScratchJr center?	Calm Worried Nervous Excited Pre occupied Anxious Confident **Other:**
19. Does the teacher encourage independent problem solving?	Yes / No Describe:

20. Is there conflict amongst students during the lesson with ScratchJr? ** Conflict as defined by situations where disagreements arise amongst students, which might require intervention from the teacher.*	Yes / No Describe:
21. Is the conflict related to programming?	Yes / No Describe:
22. Does the teacher intervene during conflict?	Yes / No
23. If the teacher intervenes, how much does the she intervene to resolve conflict? *1: Teacher does not intervene at all* *3: Teacher intervenes but allows students to come to their own resolution.* *4: Teacher is fully involved in conflict resolution among students.*	Very little 1 2 3 4 A lot Describe:

24. If teacher intervenes, what are the ways in which she intervenes during the conflict?	Please tick all that apply: o Teacher asks questions to help students understand how to solve the issue. o Teacher gives instructions on how to solve the problem. • Teacher raises his/her voice o Teacher takes child aside to talk to him/her o Teacher issues a time-out to at least one student o Other: ______________________________
25. Is teacher aware of the unspoken needs of students during the lesson with ScratchJr?	Yes / No Describe:
26. How much sensitivity does the teacher have towards students? i.e. How does she handle unspoken needs of the student? *1: Teacher is hardly aware of the unspoken needs of a student* *3: Teacher is able to understand the unspoken needs of a student* *4: Teacher is able to read the unspoken needs of a student and react appropriately in handling any issues that arise.*	Very little 1 2 3 4 A lot Describe:
27. How does the teacher show sensitivity towards students?	Describe:

28. When students are not sitting where they are supposed to, how much does the teacher intervene? *1: Barely any intervention* *3: Moderate intervention e.g. reminders.* *4: Very involved (speech and action) in getting students to do what he/she wants them to do*	Very little 1 2 3 4 A lot Describe: Students are sitting in their allocated positions
29. When students are not doing what the teacher wants them to do on the iPad, how much does the teacher intervene? *1: Barely any intervention* *3: Moderate intervention* *4: Very involved (speech and action) in getting students to do what he/she wants them to do*	Very little 1 2 3 4 A lot Describe: Students are doing what teacher wants them to do on the iPads
30. When students talk out of turn (e.g. interrupt the teacher, or interrupt each other), how much does the teacher intervene?	Very little 1 2 3 4 A lot Describe: Students do not talk out of turn/ interrupt the teacher
31. How does the teacher end the lesson? - If the end of the lesson is not observed, please put N/A	______________________________

32. Are there supplementary materials given to students?	Yes / No
33. Does the teacher encourage collaboration?	Yes / No
34. How does the teacher encourage collaboration?	Describe:
35. Did the teacher have explicit goals for the lesson?	Yes / No
36. If there was an explicit goal, to what extent did the teacher accomplish those goals? - Skip this question if there was no explicit goal observed. *1: None or very few students are doing/have done the task the teacher has set out for them.* *3: Some are doing/have done the task teacher has set out for them.* *4: Most or all of the students are doing/have done the task teacher has set out for them.*	Very little 1 2 3 4 A lot Describe:

Appendix C

Coding Protocol for Students

Date:
Class:

• How attentive are students during the ScratchJr lesson? • *Barely paying attention – most doing their own thing* *3: Most of them are paying attention* *4: Almost everyone is paying close attention to what the teacher is saying.*	Very little 1 2 3 4 A lot Notes:______________________________ Teacher is not explicitly teaching - students are doing their own thing
2. How do students use iPads when teacher is teaching?	• Most are listening <u>and</u> using their iPads • Most are listening without looking at their iPads 2. Most are not listening to the teacher • Teacher is not explicitly teaching - students are doing their own thing Other:
6. Do students ask questions in class?	Yes / No

4. What type of questions do students ask when using ScratchJr?	7. Questions related to programming in ScratchJr 8. Questions not related to programming in Scratch Jr 5. Questions not related to ScratchJr Describe: ________________________________
5. Do students ask follow up questions?	Yes / No ________________________________
9. What types of follow up questions do students ask?	• No follow up questions • Follow-up questions related to programming in ScratchJr 2. Follow-up questions not related to programming in Scratch Jr 2. Follow-up questions not related to ScratchJr
12. Do students collaborate spontaneously in class? ** Collaboration that is initiated by the student. An example being a student showing his/her work to a classmate; or a student asking a classmate for help.*	Yes / No

8. If “Yes”, when do students collaborate?	2. Students collaborate during programming 2. Students collaborate when using non-programming functions in ScratchJr 2. Students collaborate during non-technological tasks
13. If collaboration is observed, what is the level of collaboration observed? *1: One or two students collaborating* *3: Moderate collaboration: about half the table is shows some form of collaboration at any point in time* *4: A lot of collaboration: almost all the students at the table collaborates collaborate at some point during the lesson*	Very little 1 2 3 4 A lot Notes:______________________________

10. How do students collaborate?	Please tick all that apply: 2. Working together in groups of two or more 2. Asking questions among themselves 2. Express need for assistance to other students 2. Showing each other their work 2. Helping or offering to help each other out without prompting from the teacher (for example, showing another student how to move the block) • Taking photos using the camera function in ScratchJr. Other:
14. Is there conflict amongst students during the lesson?	Yes / No Describe: ___________________________________
15. If "Yes", does conflict occur when students are programming?	2. Conflict occurs when students are programming 2. Conflict occurs when students are not programming in ScratchJr 2. Conflict occurs when students are not using iPads (while at the ScratchJr center)

13. How much programming did students do during the lesson? *1: No programming observed* *2: One or two students programming* *3: Moderate programming: about half the table attempts to program during the session* *4: A lot of programming: More than half the table attempts to program.*	None/Very little 1 2 3 4 A lot Notes:______________________________

Appendix D

ScratchJr Fall 2013 Assessments Guide

Contents

1. Overview
2. Setting Up
3. The Assessment
4. Running the Assessment
5. Solve-Its

1. Overview

This guide will outline how to assess students' understanding of instructions and sequencing in the context of the ScratchJr iPad app. These assessments were originally designed to evaluate student learning in K-2 classrooms after finishing the ScratchJr "Animated Genres" curriculum (http://www.scratchjr.org/teach).

2. Setting Up

To conduct these assessments, you will need an iPad with ScratchJr installed and means to project it so each student being assessed can see it well. Each "Solve-It" project should be preloaded on this iPad.

Each student gets one (1) "Circle the Blocks Handout". Each student should have one (1) writing utensil.

3. The Assessment

"Circle the Blocks"

Students examine a project as it runs and circle which blocks they think are part of the project's program in the section of the "Circle the Blocks Handout" corresponding to that project.

Ensure that every student understands the following:

- He/she cannot look at other students' answers
- He/she may not have enough time to finish each "Solve-It"
- He/she must write their name clearly on the bottom of their "Circle the Blocks Handout"
- He/she does not need to worry about number parameters or filling in the words for the "Say" block

4. Running the Assessment

For each of the “Solve-Its” do the following:

1. Announce the number of the “Solve-It” so the students know which part of the handout they should be writing in.
2. Announce which activities the class will be doing, e.g. “For this ‘Solve-It’ we will only be circling the blocks.”
3. Display the project in “Presentation Mode.”
4. Make sure the class sees whether the teacher begins running the project by tapping a character or by tapping the green flag.
5. Once the project finishes running, reset the project manually by moving the characters back to their original places on the screen.
6. Repeat steps 2-3.

At the end of the assessment collect all the materials.

5. Solve-Its

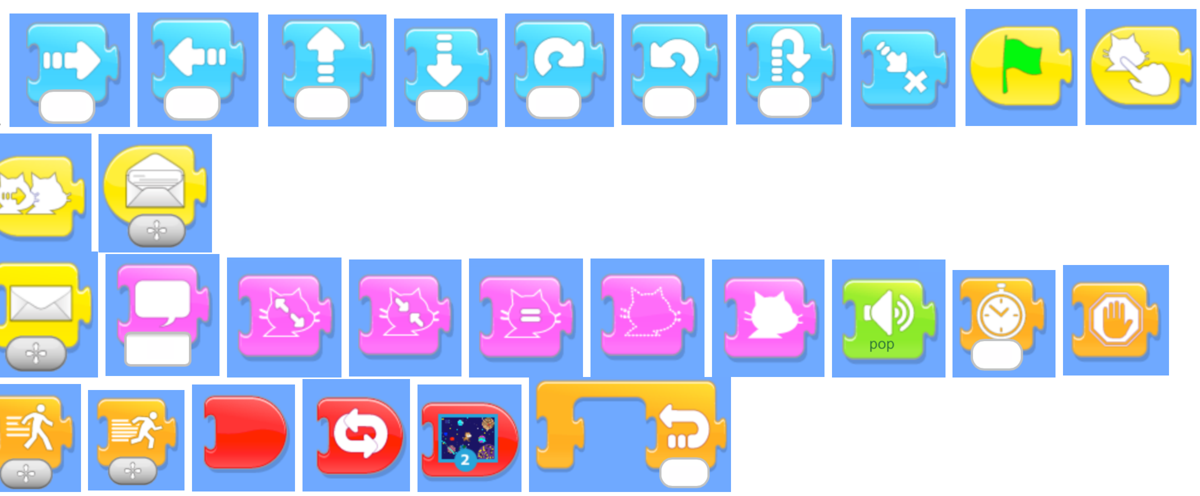
1. Cat Program: Start on green flag, hide, show

   This is a warmup exercise. It is not meant to be used for data analysis.

2. Cat Program: Start on green flag, right turn (2), left turn (2), move up (2), move down (2)
3. Cat Program: Start on green flag, hop, wait (6), hop
4. Cat Program: Start on green flag, grow (2), shrink (2)

Solve-It Assessment Sheet

1.


2.


3.