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## Original Paper

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# Promising digital practices for nondominant learners

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ABSTRACT

This case study took place during an after-school program in a public Texas school district along the U.S./Mexico border. We explore a focal participant's technology access and use as part of our larger digital literacy research. We asked: What in- and out-of-school digital literacy skills, access, and experiences did Robot Boy (pseudonym) possess? How did he behave as a rhizome? Overarching theoretical frameworks were postmodernism and New Literacy Studies; within these theories, we focused on rhizomic principles and digital literacies. This research is part of a larger mixed methods research study (Bussert-Webb & Henry, 2016) focused on an exploration of Latino children's digital literacy and online reading. Data sources included participant observation, interviews, and the Digital Divide Measurement Scale for Students (DDMS-S). Interviewees included 16 children (including Robot Boy) and six Latino staff; 310 children (87% Latino) responded to the DDMS-S. Emerging qualitative themes were Robot Boy's responses to rhizomic rupture. Robot Boy, a bilingual and biliterate middle school youth, demonstrated promising digital practices, which we can apply to other nondominant learners. He assigned rupture by reworking restrictive maps, collaborating with others, and valuing diversity to create multiple pathways.

## Introduction

This research explores how a Latino and native Spanish speaker lacked school mentoring in digital literacies in South Texas, USA; however, he circumvented obstacles, used digital tools to create products, and connected with others digitally. This case study of a focal participant presents promising digital practices for nondominant learners, involving these rhizomic principles: connection (human relationships), multiplicity (making things proliferate nonlinearly), assigning rupture (working around obstacles), heterogeneity (diversity), and cartography (openness) (Deleuze & Guattari, 1987). Digital literacies are ever-changing literacy practices, stances, skills, and strategies that enable us to represent and understand ideas through digital tools and multimodalities (O'Brien & Scharber, 2008). Research questions were: What in and out of school digital literacy access, experiences, and skills did Robot Boy possess? How did he behave as a rhizome? All names are pseudonyms.

These questions are important because Latinos represent about 18% of the U.S. population (U.S. Census Bureau, 2016). By July 2015, around 57 million Latinos lived in the USA; that number may climb to 119 million by 2060. Latinos may constitute 29% of the U.S. population by then (U.S. Census

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Bureau). Arizona, California, Colorado, Florida, Illinois, New Jersey, New Mexico, New York, and Texas have at least one million Latinos per state (U.S. Census Bureau). Thus, this study applies to many geographic areas and to the educational future of the USA.

Yet, what will this future look like if about one third of the USA lives in poverty and receives less formal education? The Latino poverty rate is about 21%; less than 15% of Latinos (ages 25 and older) possess a bachelor's degree or higher, and about 34% of Latinos lack a high school education or equivalent (U.S. Census Bureau, 2016). Latinos represent the most poorly educated U.S. group, mostly due to inadequate educational support, e.g., less-skilled and experienced educators and over-crowded schools (Gándara & Contreras, 2009). Foreign-born and U.S.-born Latino students drop out of primary and secondary schools at a significantly higher rate than do their English-speaking peers (Ross et al., 2012). Based on estimates for entering freshmen graduating in four years, the high school graduation rate was 79% for white males and 84% for white females, but 60% for Latino males and 70% for Latinas (Ross et al.).

Because our U.S. study combines literacy and technology, we report related U.S. statistics. For example, language-minority youth score lower in U.S. reading achievement tests (Ross et al., 2012). Latino children of less-educated parents read less than children whose parents have some college (Wartella, Kirkpatrick, Rideout, Lauricella, & Connell, 2014). While test scores and printed texts are not the sole sinew of literacy, they are literacy facets. Regarding technology, Latinos experience significantly lower home-based Internet access than whites in the USA (Wartella et al., 2014). Latinos are less likely than whites to access the Internet or own a computer (Katz & Levine, 2015). Significant differences in tablet and smartphone ownership occur among U.S. Latino participants, based on education, income, and language; thus, much variation exists within Latino populations (Wartella et al.).

These statistics relate to Robot Boy and his 309 peers in our larger digital literacy study (Bussert-Webb & Henry, 2016). Although most youth had access to digital tools and high-speed Internet at home, they lacked digital mentoring in school. In Bussert-Webb & Díaz (2012), low-income Latino youth reported high out-of-school technology access, but limited digital-related school activities and homework. Nationally, teachers from low-socioeconomic status (SES) districts with high minority populations are less likely to assign Internet-related homework than their colleagues in high-SES districts with white majority populations (Henry, 2010). Also, a testing milieu permeates urban districts serving mostly low-SES nondominant youth (Bussert-Webb, 2008; Gormley & McDermott, 2014). Student use of digital literacies for authentic purposes is scarce in many low-SES schools because of test preparation (Henry, 2007; Leu, McVerry, et al., 2009). Moreover, Texas, where our research took place, scored highest for high-stakes testing among 25 states studied (Nichols, Glass, & Berliner, 2012). These tests impact staff and children greatly.

Unlike his peers who used out-of-school digital tools for mostly consumption, friendship, and entertainment (Bussert-Webb & Henry, 2016), Robot Boy used these tools for creation and interest-based reasons. Robot Boy and his parents were bilingual and biliterate in Spanish and English. Although low-income, less-educated, and Spanish-dominant parents are less likely to say their children need digital skills to succeed (Wartella et al., 2014), Robot Boy's parents supported his digital practices. This study explores results from 16 child interviews (including Robot Boy), six staff interviews, participant observation, and the Digital Divide Measurement Scale for Students (DDMS-S; Henry, 2007) that 310 youth completed, including Robot Boy.

## Theoretical Frameworks

We explore Robot Boy's digital literacy in and out of school, digital access, and technology use vis-à-vis the overarching theories of postmodernism and New Literacy Studies (NLS); within these theories, we focus on rhizomic principles and digital literacies. Postmodernism, from social and political theory, undergirds diversity in education - multicultural education and multimodalities. Postmodernists, considering multiple realities and perspectives, favor an open approach versus categories and structures (Foucault, 1972). Instead of one person or group holding power over others, postmodernists believe that discourse diffuses power and everyone possesses power (Foucault, 1980, 1991). Discourse consists of subjective communication systems (Foucault, 1972) and socially-situated identities (Gee, 1989).

Postmodern and NLS theorists embrace multiple realities. NLS scholars do not believe literacy consists of decontextualized skills within an individual. Instead, NLS scholars focus on ideological, socially-situated practices, which may include gaming, creating robots, or hanging out online (O'Brien & Scharber, 2008; Street, 2003). Additionally, NLS represent a pedagogy of multiliteracies (New London Group, 1996). Under postmodern and NLS frameworks, we emphasize rhizomic principles and digital literacies. People can use digital tools to navigate around obstacles, connect with others, and create new branches for increased digital access.

### Rhizomic Principles

In postmodernism, power is dispersed, not like tree roots, but ginger buds. Numerous nonlinear auxiliaries embody how a rhizome thrives underground. Some cannot grasp a rhizome's strength in connections. Chop off a rhizome and it will branch off in another direction. Social scientists, such as Deleuze and Guattari (1987), applied these naturally-occurring rhizomes to human behaviors and organizations, emphasizing: connection, heterogeneity,

multiplicity, assigning rupture, cartography, and decalcomania (Deleuze & Guattari). For example, nondominant learners can assign rupture by reworking restrictive maps; they connect with others and value heterogeneity and multiplicity by collaborating with diverse people to create nonlinear branches. They become cartographers (map-makers) through decalcomania or serendipity. These youth cause us to consider diversity, relationships, multiple pathways, and receptiveness to growth (Deleuze & Guattari). See also Bussert-Webb, Díaz, & Yanez (2017).

### Digital Literacies

Digital literacy, under NLS, involves engagement, meaning-making, and collaboration (Kalantzis, 2011) as well as critique (Lankshear & Knobel, 2006). People engaging in digital literacies represent ideas through tools and modes as they plan the spatial and temporal inclusion of multimodal texts to make and share meaning (O'Brien & Scharber, 2008). In NLS traditions, texts are multimodal, intentional representations used to make and share meaning within sociocultural contexts (O'Brien & Scharber). Although traditional print literacies undergird digital literacies, the latter can complement and bridge traditional print and other media. Digital literacies expand what it means to be literate. For many years, people considered the ability to read and write printed texts at a certain level to signify literacy. However, using and understanding sounds, videos, images, letters, numbers, and other nonlinear texts differ from sequential, linear print-based literacies (Kress & van Leeuwen, 2001). Rhizomes, like these multimodal digital texts, are also nonlinear, as rhizomes send out shoots from different nodes.

## Methods

We begin this section discussing case studies as acceptable types of qualitative research. Next, we explore the context of Robot Boy's city, school district, and after-school enrichment program, as well as participants, data sources, procedures, and data analysis.

### Case Study

A case study is a single example, bounded in space and time (Merriam, 1998), which fits the South Texas school district's physical demarcations and our emphasis on our 2011-2012 data gathering timeframe. While we make no attempt to generalize all Latino bilingual children, we argue a "case study is a necessary and sufficient method for certain important research tasks in the social sciences" (Flyvbjerg, 2006, p. 26). Furthermore, a case study enables an understanding of broader sociocultural contexts (Stake, 2000). Readers can glean insights into the digital literacy practices of a bilingual, biliterate youth in and out of school. A case study may include qualitative and quantitative results, also (Flyvbjerg).

### City and School District

This study took place along the U.S./Mexico border. About 74% of this city's population is of Mexican origin, according to the city's website; because our study falls under Institutional Review Board (IRB) purview, we cannot reveal the city or district. The city has about 200,000 residents and is one of the poorest in the USA, with a per capita income of $14,000 and a 63% high school graduation rate for adults over age 24 (U.S. Census Bureau, 2010).

Within this city functions Futuro [Future], the public school district where we collected data. Based on Futuro's website in 2011-2012, about 99% of its 50,000 elementary and secondary students were Latino and 96% were economically disadvantaged. Futuro identified 59% of its enrollees as at-risk for dropping out and 30% as limited English proficient (LEP). These labels, common in local, state, and U.S. governments, share deficit connotations. From a strengths-based perspective, we prefer children of promise versus at risk (Heath & Mangiola, 1991) and emergent bilinguals versus LEP (García, Kleifgen, & Falchi, 2008). Using these alternative words enables us to talk back to hegemonic classifications of culturally and linguistically diverse children. Also from a strengths-based perspective, we highlight Futuro's achievements. For instance, during data gathering, 80% of Futuro's campuses received Texas Education Agency (TEA) recognition or exemplary ratings in 2011, which indicate above-average attendance, retention rates, and state-mandated academic test results.

### Extracurricular Program

This study took place during the first year of Futuro's After-school Teaching (FAST) program, which the TEA funded as part of a U.S. grant. Only 1,400 (2.8%) of 50,000 Futuro students and 110 (.03%) of 3,200 teachers and administrators participated in FAST. FAST, administered at nine of 51 Futuro campuses after school, focused on helping elementary and middle level children with academic success. FAST activities involved homework help, college and career readiness, and enrichment; the latter ranged from gardening to sports, chess, and technology activities. According to Futuro's website, FAST engaged youth in innovative, hands-on activities and reinforced and complemented students' regular academic program, following best practices in instruction. Staff members marveled at a TEA representative's badge they spotted when she walked around their campuses to review FAST. "No worksheets!," the TEA badge proclaimed.

However, based on several data sources, many hands-on activities stopped during FAST's second semester because central office staff wanted to prepare youth for the State of Texas Assessments of Academic Readiness (STAAR). We do not wish to criticize Futuro, as this testing emphasis (to the detriment of digital literacy development) is a U.S. phenomenon in high-poverty urban schools (Gormley & McDermott, 2014; Leu, McVerry et al., 2009),

especially in Texas (Nichols, Glass, & Berliner, 2012). O'Brien and Scharber (2008) discussed the "gap between the digital literacies practices youth engage in outside of school and the ways literacy is framed in official standards and assessments" (p. 67).

**Participants**

Eight of nine elementary and middle school campuses participated in our larger study. Participants included 310 children and six staff interviewees. Of 310 youth who completed the DDMS-S, Bussert-Webb interviewed 16 (5%), all Latino. As a nested design, we chose two children per campus: one child with high and one with low home-based technology access and use, based on DDMS-S results. As purposeful sampling, Bussert-Webb chose six staff interviewees who expressed interest in technology or who taught technology during FAST.

Adult interviewees, all Latinos, represented 5% of FAST staff. At the middle level, a male coordinated Robot Boy's campus and a male taught technology skills. Four females worked at the elementary level; two coordinated FAST, one taught technology, and one was a classroom teacher. All worked at the same campuses during and after school; coordinators observed classroom interactions during and after school. Bussert-Webb, a paid consultant, organized children's field trips to a local university and served as FAST's internal evaluator.

Robot Boy, age 11 and in sixth grade, served as a focal participant who completed the DDMS-S. The DDMS-S was part of a larger study in the 2011-2012 academic year (Bussert-Webb & Henry, 2016). Of 310 children in grades three to eight (ages 9 to 14) who turned in child assent and guardian consent forms, Bussert-Webb interviewed 16 primary and middle level students, eight males and eight females. Robot Boy, like most youth respondents, experienced little technology mentoring during school or in FAST. However, Robot Boy, who helped to create a "Hello World" website the first semester of FAST, found multiple digital paths to collaborate with others. Thus, he appeared to engage in many rhizomic principles.

Robot Boy said his family encouraged his digital practices, including gaming. However, in a national study, Latino parents were more likely to hold negative attitudes about gaming (Wartella et al., 2014). Robot Boy lived with his mother and father, an older sister (in high school), and a younger sister. Robot Boy's older sister, who attended a robotics session at the local university, inspired Robot Boy to pursue robotics and technology careers. Robot Boy's father planned to have games installed on Robot Boy's phone. Yet most of Robot Boy's peers reported sharing cell phones with family (see also Bussert-Webb & Díaz, 2012). Additionally, Robot Boy's dad gave him a computer, whereas most of Robot Boy's peers reported using family computers only. Robot Boy reportedly owned these devices: Super Nintendo, Nintendo 64, GameCube, cell phone, a computer, and several video games.

Besides technology, Robot Boy chose chess and drama activities in FAST. He also participated in his school's orchestra before school and mentioned going to Mr. Gatti's, a pizza and game restaurant, occasionally with band members and teachers. Robot Boy said his mother made him text her every 30 minutes (in Spanish) when he was at Mr. Gatti's to let her know he was fine. His mother's frequent use of texting to communicate with her son demonstrated some involvement in his digital world.

**Data Sources**

Data sources included participant observation, child and staff semi-structured interviews, and the DDMS-S. Bussert-Webb documented field notes as she interacted with elementary and middle school children and staff in computer labs and classrooms when they took the DDMS-S. Her role as internal grant evaluator provided the opportunity to cross-reference the child and staff interviews and DDMS-S results.

The 20-question, semi-structured child interview focused on digital technology access and practices in school and at home. See Tables 2 and 3 for child interview questions. At the end of each child interview, Bussert-Webb asked follow-up questions for clarification and summarized the documented responses as a form of member-checking.

The semi-structured staff interviews consisted of eight questions on coordinator and teacher perceptions regarding the children's technology access and use during school hours and at home, as well as what staff envisioned as important digital skills for the children. Sample questions were: "Can you speak about the ways children use technology during school, in FAST, and at home?" and "What is your goal for the children's technology knowledge and skills?" Follow-up interview questions were for clarification and exploration. For member checking, Bussert-Webb emailed transcripts individually to each participant, who reviewed their transcript for accuracy and made corrections.

We used the DDMS-S to determine children's technology access, use, self-efficacy, knowledge, and skills. We divided the scale into two parts: 1) computer and Internet access and use inside and outside school, and 2) Internet searching and critical evaluation of web-based information and self-efficacy related to digital literacy skills. A sample question from part one included, "Where do you use the Internet most often?" (home, school, or someplace else). A sample question from part two, "What clue tells you that you probably cannot trust this website?", included a screenshot from a spoof website (i.e. whitehouse.net) that contained a photo of the White House with a billboard space for rent on the front lawn. An exploratory factor analysis

(Thompson, 2004) resulted in identifying three interpretable factors: 1) Internet access inside and outside school, 2) Internet use inside and outside school, and 3) Internet reading skill as a measure of online reading comprehension, including reading to locate information and reading to critically evaluate information (Henry, 2007, 2010). Validation procedures to test DDMS-S psychometric properties included content validation (Netemeyer, Bearden, & Sharma, 2003) and two internal consistency estimates of reliability (i.e. split-half coefficient - .9389 and coefficient alpha = .9345), indicating satisfactory reliability (Green & Salkind, 2003).

**Procedures**

Data gathering transpired during FAST. Tape-recorded, transcribed interviews with Robot Boy, other child participants, and staff members took from 30 minutes to one hour each. Bussert-Webb interviewed each child in a corner of the computer lab while other youth used the computers. She interviewed coordinators in their offices and teachers in their classrooms.

Bussert-Webb also took field notes in the computer labs and classrooms at the nine schools during FAST. Her notes focused on how the children were using technology, what their tasks were, and if they were working alone or with others. She visited at least one school each week as a participant observer and had two opportunities to observe Robot Boy interacting with his peers and a teacher in a computer lab. On one occasion, he and his peers were playing face-to-face chess, as this was one activity he chose. On another occasion, he and some peers were playing a discrete-skills math game against each other in the same computer lab as a competition.

**Data Analysis**

Qualitative analysis consisted of grounded theory, in which we read the data several times, looking for patterns based on our theoretical frameworks and research questions (Corbin & Strauss, 2008). An initial theme was the influence of high-stakes testing on Robot Boy's technology usage, but this initial theme appeared to support the more salient themes of rhizomic principles ruptured and enhanced.

We analyzed quantitative data to provide additional insight into Robot Boy's technology skill level and usage, compared to his sixth-grade peers. For this purpose, we isolated DDMS-S data by grade level; we employed descriptive and inferential statistics on key variables related to technology access, use, and online reading skill level.

## Results

The first theme, digital literacy skills, is based on DDMS-S results for Robot Boy and his peers. The other two themes focus on rhizomic principles broken and enhanced.

**Digital Literacy Skills**

Table 1 illustrates Robot Boy's scores compared to the mean scores of his sixth grade and middle level peers on part two of the DDMS-S; part two focused on assessing children's online reading comprehension, including locating and critically evaluating information.

Table 1

*Mean Scores for Locating and Critically Evaluating Information*

| Measure | Robot Boy | Sixth Grade Peers | Middle Level Students (Grades 6-8) |
|---|---|---|---|
| Composite Online Reading Comprehension | 7.0 | 1.87 | 4.56 |
| Locating Information | 5.0 | 2.4 | 2.56 |
| Critically Evaluating Information | 2.0 | 2.16 | 1.95 |

As Table 1 shows, Robot Boy was more sophisticated in his online reading composite (7.0 of 14.0) and locating information score (5.0 of 6.0) than other sixth graders and middle level students, who included sixth, seventh and eighth grades. This relates to his other survey response about using the Internet to learn more about his own interests and locating clipart and videos. His score on critically evaluating information was similar to both groups. In fact, his mean (2.0) was just a little above the elementary students' mean (1.95) for critically evaluating information; the highest possible score for critically evaluating information was 8.0 (Bussert-Webb & Henry, 2016).

**Creating Rupture**

This theme focused on creating rupture (breaking a rhizome's path). Participant observation, staff interviews, and DDMS-S data confirmed this theme. Some staff interviewees did not believe the youth possessed computers and Internet at home or that youth negotiated obstacles to obtain access; e.g., using family and neighborhood resources. One elementary teacher said, "A lot of the kids don't even have computers at home." An elementary coordinator related children's out-of-school access to poverty and parents' educational levels:

> When you deal with children from a low socio-economic area, they don't have access to computers at home. So, they're just limited to access at school and most of their parents are not college graduates, and so they don't use computers. If you've been to college, you probably have a computer at home. If not, you probably don't have one. If you 're poor, you probably can't afford to buy one.

These myths can prevent teachers from assigning rigorous digital homework to nondominant children in poverty (Bussert-Webb, et al., 2017; Bussert-Webb & Henry, 2016). Furthermore, most staff believed teachers at their campuses lacked technology training and that most instruction during the school day focused on test preparation. According to one elementary coordinator:

> I feel that most of the teachers are very overwhelmed with passing the state tests that they don't feel that they have time to be as innovative as they could be, especially in the area of technology … We're not implementing a lot of technology programs we could because the teachers lack training.

Thus, inadequate teacher training and high-stakes tests prevented innovative technology use during school. Elementary and middle school coordinators, teachers, and children interviewees mentioned using "Tech for Tests" during FAST. However, FAST was supposed to be authentic and inquiry-based. An elementary coordinator discussed this testing emphasis during FAST:

> Like I said, they have Kids College. It's a program they go into and it assists them with reading, math, and science, and it assesses how they're doing. It gives them, like, benchmark tests and based on their results, it gives them a pathway in the area they need to improve in.

The Kids College digital program incorporated benchmark tests and remediation, hallmarks of "Tech for Tests". Table 2 presents the emerging qualitative theme of rhizomic principles broken.

Table 2

*Robot Boy and Rhizomic Principles Broken*

| Interview Question | Robot Boy's Answer | Rhizomic Principle Broken |
|---|---|---|
| What do you do on the computer during the after-school program? | In this program well mostly sometimes, well, we'll do a packet where we learn about the computers. They're lessons. Then if we still have free time we'll play with the computer. We'll like, read the lesson and then the last two pages are questions (motioning with hands that it's paper). … Then they took out technology due to the fact that we needed more educational [sic]. So, when they brought it back, we started doing the lessons about the computer. | Creating rupture: Due to high-stakes tests, administrators banned most hands-on technology use in the spring, unless children finished hard copies of tasks. "If we still have free time" signified technology was an add-on and that staff used a behavioristic model of stimulus-response. |
| What have you learned about technology from the after-school program? | I've learned a lot about the inside of the computer, the mother board, how bits and bytes work. I also learned about how ram and rim, or was it rim and ram? I hope so. We learned a lot and I sometimes forget, but he lets us keeps the packets, the lessons, so we can go back and review. | Creating rupture: Reading about technology versus using technology for authentic purposes confused him and made school-based technology shallow, despite his technology interest. |
| During school, what is the primary reason you would use a computer? | During school, I will usually use a computer for AR [Accelerated Reader] or to do typing in Microsoft. [Follow up: When do you type in Microsoft?] Tech class. It's basically to learn how to type. [AR is a computer program in which children take tests over hard copies of novels they read. They receive points and prizes based on their test scores.] | Creating rupture: He used technology in school for keyboarding and AR tests. These were low-level computer uses, involving no online reading or digital literacy skills. |
| What have been your experiences with technology-related school projects? | Uh, researching for different states. I remember in history, we were supposed to research a state, and I forgot … Well, I haven't gotten projects in the computer for math or science. | Creating rupture: He had assigned tasks versus autonomy during school. He did not appear to engage in technology-related projects for other disciplines. |

| How do you feel about the ways you use technologies inside of school? | Basically, inside of school it's just regular for me. Like I mean, uh, typing at home. At the program Scratch, I type a lot. In technology class, I'm basically typing the words. I look at the sentences to type. For AR, it's not related to what I do at home. I don't think I have an answer. [Follow up question]. Yes, I keep learning more and more about the technology I use every day. When I'm typing the sentences, I learn how to type faster so I can finish the game [at home] way faster. For AR, it's just basically just testing on a book you read, so I don't use the testing at home. | Creating rupture: School-based technology helped him at home only to type faster for Scratch. School technology purposes did not relate much to his passions. |
| --- | --- | --- |
| Here is a cell phone. Please talk aloud and tell me what you're doing. | If I'm bored I will text my friend. That's what I would do, just text my friend. My dad said he was going to take me to the Cricket store and get money on the phone so I could get games. | Creating rupture: He had only calling and texting available on his flip-phone. He could not use the Internet or airdrop.<br><br>Assigning rupture and connection: His father planned to pay for games Robot Boy could play on the phone and have more multimodal experiences. |

**Rhizomic Principles Enhanced**

The previous theme emphasized rhizomic principles broken due to inadequate school resources and staff members' beliefs and practice. However, this theme, rhizomic principles enhanced, is positive. Included are these sub-themes: cartography (openness), connection (collaboration), heterogeneity (diversity), multiplicity (making things proliferate nonlinearly), and assigning rupture; the latter signifies working around obstacles and creating secondary roots that thrive (Deleuze & Guattari, 1987). Furthermore, creating rupture and assigning rupture can occur simultaneously. For instance, in the last cell of Table 2, Robot Boy reported his flip-phone had limited capability, but that his father was going to visit the family's cell phone provider to install more games on Robot Boy's phone. Because the study took place in 2011-2012, automatic App downloads were not as popular and flip-phones were more popular. Again, DDMS-S data, participant observation, and other staff and child interviews confirmed these findings.

Robot Boy shared in interviews and the DDMS-S that he used a computer during FAST to play online chess (e.g., https://www.sparkchess.com). Thus, he could rhizome around some of the test-preparation seeping into FAST. DDMS-S data also showed he used the computer and Internet to learn more about his own interests a few times each week for Skype and locating clip art or videos. He said he used clip art and videos to enhance games he created through Scratch. Although more sophisticated programs to create games exist, involving construction of three-dimensional figures, Scratch was what Robot Boy used.

Based on DDMS-S results, Robot Boy (like about 70% of Futuro sixth graders) *did* possess working computers at home. One elementary coordinator realized that children in poverty could rhizome around inadequate family resources: "Yet I've seen families with dilapidated houses with iPads and big screen TVs. I saw a 5-year-old from one of these homes with an iPad." Robot Boy indicated having two computers in his home connected to high-speed Internet. Most (83%) sixth graders with a home computer reported Internet access at home and 30% reported two or more Internet-connected home computers. However, only 33% of his sixth-grade peers reported having high speed Internet. Importantly, nearly 58% of sixth grade students "did not know" what type of Internet connection was available to them. When asked about computer ownership, Robot Boy stated he owned the computer that he used most often, while 22% of sixth graders made this claim.

Although Robot Boy enjoyed more digital access outside of school than his peers, he worked around inadequate digital mentoring and experiences at school, explored in Table 3. Next, some children and staff, and even Robot Boy, reported engaging in some authentic digital activities during school and for homework, e.g., researching famous people and schools in other countries, conducting online research for science fairs, and sharing results with peers. We did find some instances of decalcomania (serendipity) in Table 3, rows 2 and 3. We are including decalcomania as an illustration, since it is a rhizomic principle (Deleuze & Guattari, 1987). However, it was not a subtheme from data analysis because it only emerged in two instances.

Table 3

*Robot Boy and Rhizomic Principles Enhanced*

| Interview Question | Robot Boy's Answer | Rhizomic Principle Enhanced |
| --- | --- | --- |
| What do you do on the computer during the after-school program? | I know in the first semester, we'll do [sic] Hello World. We made our own website. | Connection and cartography: Robot Boy, peers, and their after-school teacher created a website. They opened themselves to the world. |
| Can you name the types of technology you use at least once | Well mostly the computer because I do a lot of things with the computer. I downloaded this program called Scratch, which is really cool 'cause it has a lot of codes and formulas and scripts | Multiplicity and assigning rupture: He learned about math and technology connections outside of school through Scratch and he created several |

| a week at home? | and what you can do with these scripts is make your own character or you can go to Google and save your own picture, and you can delete the ones, the parts you don't need. [Follow up question about the characters.] More information about the character. They're called sprites. With the sprite sheet, you can get the movements. You can get whether he's walking this way or that way [motioning] or just standing. When you get these, you just put, uh, what's it called? Import. To import a picture, a sprite, you click the import button and then you just go to the file and get your character. Then you press edit. Delete the things you don't need. Then you go to the script. You have to get all the costumes first. And then with the script you are able to, like, when you press the left, it will start moving to the left. It's not that simple, though. You have to use a lot of mathematics because, let's say when you want the characters to move. If you put 100, they will fly off the screen. If you put 10 by 10, they will walk an inch or so … Sometimes when I finish my homework I'll use Scratch and watch videos on ideas for Scratch. Sometimes I will be working on a game. It takes a long time. Five minutes can be an hour probably to someone else 'cause I'm so into it, getting the characters, getting the script, I was working on it. And my mom said, [name], "Go take a shower." I started at 5 (p.m.) and it was 8 when she told me and it takes me a long time to do the game. | characters for his game at home through Scratch and Google.<br><br>Cartography (openness): Robot Boy embraced multimodal learning and learning about math naturally through the Internet.<br><br>Decalcomania (serendipity): He let his interests in creating a game guide him through a serendipitous process of creating characters and movements. He used a serendipitous process to figure out how fast or slow to make the sprite characters move. |
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| How else do you use technology at home? | Sometimes when I have free time, I will play Wii with either my cousins or sisters because I'm the only boy in the house. [Follow up question]. Super Mario Brothers. Super Smash Bros. Brawl. It's because all of the Nintendo characters collide into one epic battle against evil. I also play Monster Game. It's a monster truck game. I usually play it with my cousins because my sisters don't like monster truck. I also mostly play Wii Sports, which is a game in which you interact with the sport. You actually work out [get exercise] by playing video games … On the weekend, I will probably spend three hours working on the game [which he created]. Then the rest of the time I will play outside or play Wii with my friends or cousins or sisters. It depends on how into the program I'm in. It felt like 10 minutes and it was actually three hours. I'm not just a gamer. I also love robotics. 'Cause I made a robot from Lego pieces. I got a small motor and I placed it in a robot and I attached it to wheels. I have a video on it in my USB and I left it in my class. [Robot Boy ran down the hall to find the USB. He then showed the video of his robot moving]. | Connection, multiplicity, and heterogeneity: He played different video games. He was sensitive to female players' interests. While most middle school boys bristle at gaming with girls, he did not mind.<br><br>Decalcomania: He created video games and moving Lego robots, which he recorded onto his flash drive. He lost himself in time creating games because of his passion. |
| Who owns the computer, cell phone, and hand-held games you use? | The computer? Well, it used to be my dad's, but since I started showing my dad what I like to do, then he gave me the computer until I get a laptop. The Wii is basically for the whole family, except I use it the most. The game boy and DSi? Mine. The cell phone used to be my dad's, but he gave it to my sister, which [sic] gave it to me. She gave it back to him and got a touch phone. He got a new flip phone and he gave it to me. I also have a Super Nintendo, which is basically the old, very old Nintendo console. I play it. I actually have it in my room next to my GameCube. [Follow-up question]. A game cube is like how it says, a cube. Power, reset, and open. Put a disk in it and start playing. I also have a Nintendo 64 and the old, the very old Sega | Cartography: He did not mind playing old games. No game or digital tool seemed beneath him. He owned several digital tools, many of which were second-hand.<br><br>Connection and multiplicity: His dad listened to him and saw his products. Robot Boy exchanged multiple resources with immediate and extended family. |

| | Dreamcast. The Dreamcast, I lent it to my cousin. The Nintendo 64 is still in my house. I want to take it out of my closet and put it somewhere, but we don't have enough room. | |
|---|---|---|
| What do you do when you use the Internet outside of school? | I do like playing games, making my own games, creating videos. That's my next step for technology for me; I could use the videos to make intros to the games. | Cartography: He realized he could use videos to make introductions to the games he created. He challenged himself constantly. |
| Have you ever looked up any information on careers or college outside of school? (If so, when? Why?) | Well my sister, she's in high school now, she was asked to go to this university, and when she came back she started telling me that I could do robotics or technology when I grow up, so basically, I have been looking for careers for quite some time now. | Connection and multiplicity: His sister learned about robotics and technology from others. She inspired him to pursue and research both careers. |
| If you have a problem finding something on the Internet, where do you go for help at home or in your neighborhood? | Mostly my dad, but he has work, but if it's not my dad, it's usually my sister. [Prompt: In high school?]. Yeah. | Connection: His dad and sister helped him with digital tools and web-searches. They served as his technology mentors. |
| Pretend your computer or printer isn't working. Who could fix the machine? Where would you go to get it fixed free or inexpensively? | My dad, first of all. And if he can't help me, my dad will call my cousin, one of my uncles, or my cousin are basically good with technology | Connection: His dad, uncles, and cousins were good at fixing computers and printers. |
| Which computer or video games do you play? | Well Super Smash Brothers Brawl is one of my favorite games. It has a Wi-Fi mode when I can play with my friends, but the rest of my games don't have Wi-Fi. Super Mario Brothers and Wii Sports came along with the Wii 'cause the Wii is a limited-edition Mario Wii. | Connection, heterogeneity, and multiplicity: He played many games with friends. Some games were Internet-based so they could play from multiple locations. |
| Follow-up question: Do you use game cheats? | I don't like cheats a lot, but I do use walkthroughs. [What are walk throughs?] Walk throughs are videos that people make to help other people pass the game. I don't like cheats. The reason I don't like cheats is because you'll have too many advantages and the game won't be fun anymore. | Assigning rupture, heterogeneity, and connection: He worked around game obstacles. He used maps (walk-throughs) to develop his schemata, but did not like tracings and ready-made answers (game cheats) (Deleuze & Guattari, 1987). |
| Do you have any friends you met on the Internet when gaming? | As I said, only Super Smash Brothers is the only one with Wi-Fi, and I met this boy one time and for some reason I can't find him anymore. But we used to play a lot, many, many, times, but he stopped showing up where I go, which is kind of weird. The game is made for safety. They will hide the information. All they will show is the screenname. You cannot put anything. If you're playing with friends, you have to know their game code and their Wii code. | Connection, heterogeneity, and multiplicity: He used to play online with another boy, who lived in an unknown place. |
| Do you text? In what circumstances do you text in Spanish? In what circumstances do you text in English? | Yes. When I'm bored. Sometimes both. Spanish when I'm telling my mom. Basically, my mom told me whenever my dad picks me up to always text her that he picked me up and she says if he doesn't pick me up by 3:30 to text her. Or when there's a band party at Mr. Gatti's, she told me to text her every 30 minutes to see how I'm going [sic]. When I text my friends, I will just text in English. | Connection, heterogeneity, and multiplicity: He texted in English and Spanish to friends and family. His parents knew how to send and receive texts. He was in band, which expanded his multimodal connections to others. |
| What have been your experiences with technology-related school | Uh, math, you see, I usually use my brain a lot and I use the computer to get the answer. | Assigning rupture: He used the Internet to help him figure out math answers. He did not indicate whether he used a computer during school for math. |

| projects? | | |
|---|---|---|
| Here is a laptop. Please talk aloud and tell me what you're doing. | Straight away, I will quickly go to the Scratch website, download the program to the computer, and get started quickly on a new game. You basically create the character and the movements and also enemies and also you basically make the levels, the platforms, where they stand. [Follow up about costs]. It's free. | Assigning rupture: He knew where to go to download the free game. |

## Discussion

Most middle school children had high-speed Internet and computers at home or they used neighborhood resources; however, most staff did not realize this and did not engage these youth in technology-related homework. When Bussert-Webb asked staff interviewees if they believed Futuro children possessed high-speed Internet and working computers at home, most said no. (Anecdotally, she asked Futuro leaders the same question; they said no.) Based on participant observations, DDMS-S data, and child and staff data, it appeared most school technology use focused on test preparation, discrete skills, and keyboarding. Yet, as this is a case study, we do not wish to generalize.

Robot Boy incorporated several rhizomic principles by creating video games and a robot that he showed Bussert-Webb. He also developed a website with his peers during the first semester of FAST. Robot Boy shared technology tools with family and friends and taught and learned from these people; he was aware that he used mathematical concepts when he created a video game and played video games with people online. His case illustrates the rhizomic principles of assigning rupture, cartography (creating maps), connection, heterogeneity, and multiplicity in digital literacy (Deleuze & Guattari, 1987). These rhizome ruptures relate to Gormley's and McDermott's (2014) study of high-poverty urban versus low-poverty suburban schools. The urban youth in their study relied on out-of-school resources and mentors because their digital access and mentoring were poor in school; see also Henry (2007).

Despite the children's valiant effort, Gormley's and McDermott's (2014) urban youth demonstrated lower skill levels than their suburban peers in computer skills, word processing, and Internet and presentation software. Students' digital skills relate to teachers' digital skills (Attewell & Winston, 2003; Dolan, 2016; Henry, 2007, 2010). These studies relate to what some staff members reported in our research: Futuro teachers needed more technology training.

Similarly, in her exhaustive literature review, Dolan (2016) discussed how students in mostly high-SES schools used technology for production and creation, while students in low-SES schools used technology for drill and practice. When left to their own devices, low-income nondominant youth preferred to use technology for consumption and entertainment (Bussert-Webb & Díaz, 2012; Dolan, 2016). Moreover, Attewell and Winston (2003) found that low-SES African American and Latino children (ages 11-14) in New York City public schools engaged in digital tools for consumption, entertainment, and friendship outside of school and scored below their grade level in reading assessments. Their participants, like ours, were enrolled in an after-school program with technology integration, but their after-school teacher had little training in math, science, language arts, and technology. A few blocks away at a private school, most children, affluent and white, used digital tools for inquiry outside of school and received extensive school training in computer programming, Internet research, simulation programs, and other tools (such as Excel) for rigorous academic purposes (Attewell & Winston).

The technology-related rupture we found in aspects of Futuro related, in part, to testing pressures vis-à-vis *No Child Left Behind* (NCLB) legislation (U.S. Department of Education, 2002; see also Leu, McVerry, et al., 2009). In our study, administrators made Robot Boy, his peers, and FAST teacher stop the Hello World website that they created. As Robot Boy mentioned in Table 2, "Then they took out technology due to the fact that we needed more educational [sic]." In their review of U.S. youth's Internet and computer access and use in school and at home, Warschauer and Matuchniak (2010) found that high-stakes testing environments hindered youth's authentic digital experiences in schools, but some teachers rhizomed around inadequate access. For instance, Spanish bilingual students in a California elementary school used technology to study farm workers' harsh working conditions. However, when the children's teacher left the classroom, she could not convince her peers to continue because they were afraid the project would detract from their test preparation efforts (Warschauer & Matuchniak).

## Limitations

Many limitations of our research came to light. First, as this study took place in 2011-2012, some tools, features, and sites are already outdated. Next, DDMS-S and interview data were self-reports, which made it difficult for us to verify the results (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Because Futuro granted access during FAST only, we relied on students' and teachers' self-report data and field notes during FAST. Also, the reports from a small percentage of staff and children may be too limited to provide trustworthiness; thus, we could have interviewed more people.

Participant enrollment and the purposeful selection of interviewees were also limitations because a fraction of Futuro's teachers and students were involved in the study. Out of 1,400 children in FAST, only 310 (22%) returned signed assent and consent forms and we only interviewed 16 children (5%). Out of 110 staff members, we interviewed six (5%). Perhaps other children and staff would have reported different experiences and beliefs.

Moreover, since we are arguing that low-SES students experience less digital autonomy in school, while wealthy peers might experience a smorgasbord, we could have interviewed teachers and students at high-SES Texas public schools as a comparison. Although we did not collect data on children and staff from wealthy schools, in our discussion section, we mentioned many cases of rich digital literacy autonomy, tools, and mentoring in wealthy schools. Moreover, based on the DDMS-S, focus groups, and interviews in high- and low-SES school districts, Henry (2007) found students in the former had higher technology access and Internet-based activities during class and for homework and enjoyed more autonomy in deciding on projects and finding their own websites, while peers from low-SES districts experienced much teacher control over topics and websites. Henry stated that teachers in low-SES districts "tended to be cautionary about allowing students full access to the open Internet to find information for their research projects" (p. 165). Thus, although we did not conduct research in high-SES districts, examples in the extant literature augmented our findings.

Additionally, trustworthiness issues existed with the survey implementation. Bussert-Webb noticed some children (less than 10%) took only 10 minutes to finish parts one and two of the DDMS-S; rushing appeared more common among middle school participants. Taking a survey carelessly by clicking any answer relates to trustworthiness because it would be difficult to complete both sections in 10 minutes, with an accurate measure of one's dispositions, knowledge, and skills. Furthermore, participants may have scored better on the knowledge and skills questions if they took the survey at a more leisurely pace. We believe some students rushed because they perceived the DDMS-S to be yet another test, and they may have been tired from Futuro's test-preparation focus vis-à-vis NCLB.

Finally, we experienced time constraints and resource limitations during our research. Futuro administrators would not allow any interruption of instructional time because of test preparation. Because it was difficult to enter a school during the instructional day to observe technology use firsthand, we could not verify the staff and student accounts provided in our data.

## Implications

Because of little higher-order technology mentoring during school, many nondominant, low-income children may use technology for connecting with friends and family and for entertainment purposes (Attewell & Winston, 2003; Dolan, 2016; Warschauer & Matuchniak; 2010). This inadequate digital mentoring for low-SES nondominant youth appears related to the testing milieu (Henry, 2012; Gormley & McDermott, 2014; Henry, 2010; Leu, McVerry, et al., 2009) and inadequate digital literacy training for teachers (Henry, 2007; O'Brien & Scharber, 2008). These factors can break nondominant learners' paths to 21st Century success (Deleuze & Guattari, 1987).

We should not measure digital divide by how many devices a school or district owns. After all, Futuro's website during data gathering stated that 23,600 instructional computers were in use. Gormley and McDermott (2014) found digital use can range from test preparation to discrete skills to keyboarding. Instead of device numbers, we should factor in technology integration quality (O'Brien & Scharber, 2008). Limited mentoring in digital literacies as well as children's inadequate school access (a primary digital divide) can create a secondary digital divide focused on youth's digital practices. Both relate to digital literacy skill development, or a tertiary divide, connected to online reading comprehension and research (Bussert-Webb & Henry, 2016; Henry, 2010; Gormley & McDermott, 2014). One can only imagine Robot Boy's level of digital prowess if he had access to digital mentoring as part of his academic program.

Additionally, we can assign rupture by tapping into these community centers where youth go for homework help (Bussert-Webb et al., 2017). According to Warschauer and Matuchniak (2010), staff at these neighborhood agencies can mentor youth to engage in digital tools for authentic and critical purposes. Bussert-Webb is engaged in one such iPad project in America's poorest community. Tutorial staff and Bussert-Webb supervise and train pre-service teachers to use iPads for authentic, collaborative purposes; these pre-service teachers, in turn, mentor and teach the children, all Latinos. Without funding, Bussert-Webb's program would not be possible: "The expansion of funding for youth media programs and the enhanced integration of technology into extant afterschool programs should thus be on the agenda of educational policymakers" (Warschauer & Matuchniak, p. 218).

Yet some may state, "This is *just* technology." However, technology represents literacy and social justice issues in the 21st Century (Leu, O'Byrne, Zawilinski, McVerry, & Everett-Cacopardo, 2009). One might argue that inadequate emphasis of youth's digital literacy development exacerbates a new Matthew Effect (Stanovich, 1986), e.g., the poor get poorer. See also Pretorius and Currin (2010), especially for students in high poverty, multilingual contexts. Furthermore, when children lack adequate digital preparation, they are at a disadvantage in college and in an increasingly technology-infused workforce (Henry, 2010). Breaking nondominant children's rhizomes must stop.

Yes, some, like Robot Boy, learn to assign rupture or bypass barriers *despite* school. Yet why should they face so many obstacles? Instead of creating obstacles, educators should work to help clear them. We can ask children in private if they have digital access to complete technology-related homework at home. Those without home access may use digital tools on school grounds. Some districts have even installed Wi-Fi on busses and have parked these busses in neighborhoods with limited resources.

Besides creating access, we can tap nondominant youth's rhizomic behaviors to prepare them for equitable global participation. We can also use universal design principles to meet their strengths and needs so they can enter our curricula at different points (CAST, 2011). Yet, "a rhizome is a map, not a tracing" (Deleuze & Guattari, 1987, p. 12). Thus, no rhizomic blueprint exists. Instead, we can be creative, flexible, and more observant of children's technology use or become better kid watchers (Owocki & Goodman, 2002). Indeed, a rhizome branches, connects, and refuses containment. It "acts on desire by external, productive outgrowths" (Deleuze & Guattari, p. 14). By observing students' rhizomic behaviors, we can respect their multimodalities and we can stop privileging print literacies over new literacies (Kress, 2003).

Moving from text- and test-centric foci may scare us, so we need more training to be digital risk-takers. We can also incorporate opportunities for teacher candidates to use new tools and Apps for collaborative, authentic purposes face-to-face, hybrid, and online to better prepare them for students like Robot Boy in their own classrooms. As educators, we can become rhizomes by learning new literacies from children, students, and colleagues and by developing thought collectives across disciplines, grade levels, and spaces. This involves making ourselves vulnerable, as others may know much more than us. Yet, as 21st century educators, we must be like Robot Boy – open to change. In so doing, we can apply rhizomic principles to overcome potential policy barriers to provide better outcomes for all students.

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