FEATURE

Scratching Beyond the Surface of Literacy

Programming for Early Adolescent Gifted Students

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Abstract: Digital technology offers new possibilities for children to play, express themselves, learn, and communicate. A recent development in online practice is a shift toward youth engaged in computer programming online communities. Programming is argued to be the new literacy of the millennium. In this article, I examine the use of Scratch, an online programming community, as a means to support digital literacy for early adolescent gifted, talented, and creative students. In addition, I share the experiences of an early adolescent gifted student with Scratch and consider the use of Scratch to promote interdisciplinary curricular concepts.

Keywords: gifted education, programming, coding, digital literacy, digital media

It was a typical after-school day. My daughter, Jessica, inquired about how to make and upload an audio recording. Intrigued, I asked questions to discover Jessica's purpose for the recording and was surprised to learn she intended to audition for a part in a digital story created by an adolescent programmer living in Indonesia. Further discussion revealed Jessica was introduced to Scratch, an online programming community designed for children between the ages of 8 and 16 (scratch.mit.edu). In fact, Jessica's fifth-grade gifted teacher encouraged her collaboration within the Scratch community to create various digital products, including digital stories.

As a teacher educator who specializes in digital literacies, I consistently refine my perspectives of literacy and authentic literacy practices, especially as they connect with digital literacy. But this time, Jessica was a step ahead of me. I had not heard of Scratch. Of course, with the multimedia expansion of literacy practices, there is much we do not catch each day. Certainly, definitions of literacy evolve as expansions in media used for communication are introduced. Literacy, originally concerned with print-based texts, has expanded to include a wide variety of communication tools (Coiro, 2003; Jenkins & Kelley, 2013). An explosion in technological advances, often referred to as digital literacies, provides opportunities to creatively embed multimodal forms of communication into a staggering array of texts, where "text" itself is undergoing expansion beyond print (Cope & Kalantzis, 2009). Multimodal texts, as they are called, incorporate and integrate written, oral, visual, gestural, audio, and tactile texts to communicate meaning.

> "Creatively embed multimodal forms . . . into a staggering array of texts, where 'text' itself is undergoing expansion beyond print."

Students' literacy work in the past was viewed as passive, reflective of being a recipient of culture and knowledge. In contrast, students in a digital age of literacy actively engage in social meaning-making activities that have shifted toward multimodal cultural and textual experiences (Kalantzis & Cope, 2012; Olthouse, 2013). The mode and media selected to represent information are critical to knowledge construction and crucial to successful use of literacies (Jewitt, 2008). As the mediums used for communication continue to evolve beyond traditional written material, children and adults engage in new digital media with increasing frequency.

Digital literacy relates to skills associated with information and communication technologies (ICT). To engage with expanding and changing digital technologies, students must

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master a wide range of technological, cognitive, and social skills (Eshet-Alkalai & Soffer, 2012). Digital literacy skills integral to engagement with digital media include skills connected with photo-visual literacy, reproduction literacy, branching literacy, information literacy, socio-emotional literacy, and real-time thinking (Eshet-Alkalai & Chajut, 2010). Table 1 summarizes Scratch activities and digital literacy skills connected with them.

My daughter's experience within the Scratch community and with Scratch technology is representative of a shift in the literacy practices of early adolescent gifted, talented, and creative children. Digital technologies offer new possibilities, or affordances, for youth to play, express themselves, learn, and communicate (Schrader & Bastiaens, 2012). As a result, learners move beyond operating as students-as-receivers-of-knowledge toward students-as-producers-of-knowledge (Kafai & Burke, 2014; Lee, 2011). A recent development in online practice is a shift toward children engaged in computer programming within online communities (Burke, O'Byrne, & Kafai, 2016; Hutchison, Nadolny, & Estapa, 2016; Moore, 2013). The ability to create interactive media enables broader understanding of how these digital texts are created and function (Peppler & Kafai, 2007).

The self-directed digital literacy experiences found within Scratch are reflective of the "smart places" needed in the classroom for students gifted in language arts (Olthouse, 2013, p. 248). These smart places provide an environment where literacy experiences have a social purpose, are multimodal, and are situated within social context. Students go beyond surface literacy experiences toward deeper literacy practices, which focus on multiple ways to create meaning to include understanding elements of design and redesign. Educators can use Scratch to engage gifted students and address National Association for Gifted Children (NAGC; 2010) standards. After providing an overview of Scratch, I explore the use of Scratch for early adolescent gifted, talented, and creative students.

Table 1. Example Scratch Activities and Connected Digital Literacy Skills

Scratch Activity	Digital Literacy Skills
Interface with visual-graphical forms of instructions and messages found within projects	Photo-visual literacy
Use the remix feature to create new projects based upon previous iterations	Reproduction literacy
Identify and integrate information from multiple media sources into projects; curate a Scratch studio	Branching literacy
Identify false, irrelevant, or biased information within projects	Information literacy
Contribute in a role-playing game; collaborate with Scratch members to create a digital story	Socio-emotional literacy
Engage in published simulations and games	Real-time thinking

Scratch

"You needn't only take what you're given, you can make your own!" (Utting, Cooper, Kölling, Maloney, & Resnick, 2010, p. 5). The preceding mantra permeates the culture of Scratch. User-generated content is an integral part of digital media for youth (Beals, 2010). In response to the many technologies that try to create an experience or deliver information to kids, Scratch was created to provide technology in terms of a material kids can use to create products. Scratch is intended to function as a creativity tool to facilitate expression, communication, concepts in interactivity and programming, presentation development, and community-based learning (Traylor, 2008). While other programs (e.g., CodeAcademy, Code Combat, Tynker) teach computer programming, Scratch provides an easy-to-use programming language to create unlimited digital products within an online community of programmers.

The Scratch project began in 2003 by the Lifelong Kindergarten Lab housed in the Massachusetts Institute of Technology (MIT). Launched publicly in 2007, the Scratch website remains an active online community with participants designing, sharing, discussing, and remixing one another's projects. Scratch has been called "the YouTube of interactive media" (Resnick et al., 2009, p. 60). Created to be a social product, Scratch was influenced by an implicit belief that if learners can share and show off their accomplishments, they will learn well and learn more (Fincher & Utting, 2010). The ability to easily share products within the active community provides motivation and opportunities to learn from others (Maloney, Resnick, Rusk, Silverman, & Eastmond, 2010). Keyword tags are used to foster collaboration, which enables members to quickly find high-quality Scratch products posted by others with similar interests (Lee, 2011).

Scratch employs an intuitive block system to create programs. The block system makes programming easy to change before, during, and after program execution.

Since its public launch, Scratch has helped to introduce integral programming concepts, while providing an online community to create and share digital media (Burke, 2012). Scratch is designed to reach children between the ages of 8 and 16; however, its use has been documented with people of all ages (Kafai & Burke, 2014). Initially used in informal learning settings (e.g., after-school computer centers; home environments), Scratch is increasingly used in schools (Maloney et al., 2010).

Scratch added programmability to media-manipulation activities, popular in youth culture, to encourage children to learn via exploration and peer sharing, with a decreased focus on direct instruction compared with other program languages (Maloney et al., 2010). The three major components within a Scratch program consist of Stage, Sprite, and Script. Development of a Scratch program is conceptually similar to directing and producing a performance (Lee, 2011). A Stage serves as the backdrop to all Scratch programs, complete with background images, music, and sound. A Sprite serves as the two-dimensional actor in the "real-world show" (Lee, 2011, p. 27). Although a variety of Sprites is available, users can also easily create their own Sprites with the use of a built-in-paint tool or by importing an external graphic file. The Sprite can sing, dance, and even change its appearance. Last, the Script is a set of programming blocks, which are associated with either the Sprite or the Stage to control behavior. An intuitive user interface makes programming easy and enjoyable for children (Resnick et al., 2009). Images and sounds can also be imported or created using the built-in paint tool and sound recorder.

Purpose of Scratch

A key goal of Scratch is to introduce coding to users with no previous programming experience. To increase accessibility for coding concepts, the creators of Scratch "lowered the floor" and "raised the ceiling" for programming to get children started earlier (Utting et al., 2010, p. 2). The core principle behind lowering the floor is to limit the coding schema required to engage in the design of products in the online community. The aim is to remove or hide incidental complexities for users to begin designing products. Providing an environment whereby producers experience decreased constraints regarding the types of products they may create prompts raising the ceiling. The high ceiling provides an open platform for gifted, talented, and creative children to create self-directed experiences.

In addition, Scratch creators believe programming languages need "wide walls" exemplified by supporting numerous types of projects, for people with different interests and learning styles to become fully engaged (Resnick et al., 2009). Programs can potentially be developed for any subject, at any difficulty level, in any language (Yang & Chang, 2013). In addition, the environment allows users to learn entirely through play (Utting et al., 2010). The result is a plethora of media-rich products designed and redesigned by community members (Maloney et al., 2010).

To promote self-directed learning, the online Scratch environment was designed to encourage members to create scripting, to provide immediate feedback for script execution, and to make execution and data visible (Maloney et al., 2010). The visual programming paradigm embedded within Scratch dramatically reduces barriers to computer programming, which enables children to easily develop sophisticated computer programs (Lee, 2011). The system is always live, which means users can click on a specific command while programming to see what it is does within the program. In addition, graphical feedback shows execution, while variables and lists have concrete visualizations, so the effect of data operations can be immediately viewed (Maloney et al., 2010).

The creators of Scratch argue the ability to program greatly expands the range of what can be created and self-expressed, while also expanding what can be learned (Resnick et al., 2009). A core belief embodied by the Scratch creators is learning to code and coding to learn. Essentially, programming supports the development of "computational thinking," helping to learn important problem-solving and design strategies that carry over to nonprogramming domains (Resnick et al., 2009, p. 3). The creation of Sprites and Scripts for use later in a digital story is an example of prefetching and caching. Organizing the scripts of Sprites into meaningful, easily understandable stacks teaches children about modularization. Conceptually, Scratch is designed to promote unlimited learning (Utting et al., 2010).

Another feature of Scratch is the ability to remix designs. A remix occurs when a member takes a previously created project, adds modifications to it, and then uploads it to the site as their own version. Members are encouraged to remix programs shared within the community. As a result, more projects are remixed than the number of new projects created. Remix represents a key practice in today's networked culture and is heralded as a means to participate in an increasingly global society (Shirky, 2010). Kafai and Burke (2014) posited remix as a means for socialization and a pathway to new learning for children. Often, Scratch members use remix as a way to explore and learn complex coding or engage in sophisticated redesign of shared products (Brennan, Monroy-Hernandez, & Resnick, 2010; Kafai & Burke, 2014).

Creation of Scratch Products and Gifted Education

The most prominent feature in Scratch is the ability to create sophisticated computer programs by snapping together visual programming blocks with the use of a computer mouse. Mouse-activated programming is much easier than typing programming language constructs on a keyboard (Lee, 2011). Products are created by snapping together digital programming elements. These elements are the blocks. Similar to building with LEGOs, the programming blocks snap together to interlock (see Figure 1). The programming block menu provides nine categories of color-coded blocks to control the behavior of Sprites or the Stage. Each color represents a motion, appearance, or sound (see Figure 1). Furthermore, users can create a new block or add an external extension (e.g., LEGO WeDo; PicoBoard) to create enhanced programs. Projects can be saved to a file system or shared on the Scratch site.

The open platform of Scratch and the ability to develop sophisticated programs create a space for talent to emerge. Scratch provides a context for educators to integrate coding and the creation of digital media into the curriculum in meaningful ways. Educators can use Scratch as a differentiation tool as they implement NAGC (2010) standards. In the following sections, I explore digital stories and role-playing games (RPGs), discuss experiences of my daughter in Scratch, provide classroom application examples, and make connections to NAGC

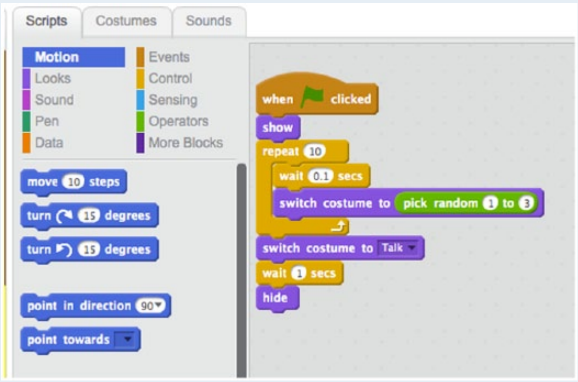

Figure 1. Example of the programming menu and blocks used to create Scratch products.
Source. Scratch is developed by the Lifelong Kindergarten Group at the MIT Media Lab. See http://scratch.mt.edu.
Note. MIT = Massachusetts Institute of Technology.

standards and the use of Scratch with gifted, talented, and creative learners.

Digital Stories

Scratch provides a medium to deploy sophisticated literacy practices in the creation of animated products. Digital stories require organization to develop a plan for telling a story. Once a plan is developed, the intuitive coding system provides tools to create and communicate a story to share with other Scratch members. Children can juxtapose available modes to create meaning via the tools provided. Written text and audio dialogue are incorporated into many of the digital stories created. The ability to embed multiple meaning-making modes within animated products allows Scratch members to communicate meaning in sophisticated ways.

The use of digital storytelling in Scratch provides an alternative way to cultivate artistic forms of communication (NAGC, 2010, 4.5.3). Crossing from print to digital modes adds an important layer to text complexity (Mills, 2011). Gifted, talented, and creative students can explore the creation and remixing of products that require a high degree of sophistication (Kafai & Burke, 2014). The open platform, intuitive coding system, and emphasis on social purpose provide the tools and context for expressing higher level thinking and creative productivity. In addition, gifted students become competent in multiple talent areas across dimensions of learning (NAGC, 2010, 3.2). Students engage in literacy processes and practices as they learn about ICT.

Upon learning my daughter wanted to submit recorded lines for auditions, I discovered a complex system used to collaborate and create digital stories. Scratch members collaborate to create animated products. Scratchers are able to follow each other and receive updates regarding recent activity. Due to her interest in the *Warrior Cat* series by Erin Hunter, my daughter began to follow Scratchers who created *Warrior Cat* products. Via the "What's Happening?" feed in Scratch, Jessica was able to learn about casting calls for *Warrior Cat* digital stories. In such instances, the creators of animated stories post casting calls with specific directions about how to audition for parts, along with a script for the audition. After each Scratcher submits their audition, the director selects the actors, and provides instructions, along with a final script for the assigned roles. The actors record their lines, which are then forwarded to the director. The director incorporates the dialogue of individual actors into the digital story. Often, collaborators will continue to work together on new projects, and studios are created within Scratch to feature these products. The collaboration described is inclusive of a variety of literacy practices beneficial for gifted, talented, and creative students (Krause, 2013; Olthouse, 2013). The members engage in reading, writing, designing, and a high degree of communication to create an animated product. And, of course, the product itself may stimulate others to remix.

Siegle (2014) posited the use of technology to animate products allows children to tap into a natural desire to tell stories and share their understandings of the world. Scratch is replete with examples of children using animation to share their understandings of the world (Kafai & Burke, 2014). Providing students with experiences to cultivate interpersonal and technical communication skills will help to develop fluency with technologies that support effective communication. The tools provided within Scratch provide gifted, talented, and creative students opportunities to engage in a wide range of literacy practices as they independently or collaboratively share their meaning with community members.

Classroom application

Mr. Taylor and his group of sixth-grade gifted students recently read *Elijah of Buxton* by Christopher Paul Curtis. While planning for instruction, he determined to focus on how the plot unfolds in a series of episodes as well as how the characters respond to change as the plot moves toward a resolution (Common Core State Standards Initiative, 2016, RL6.3). In addition, Mr. Taylor sought to design literacy experiences to challenge his students (NAGC, 2010, 3.2.1). Rather than asking his students to write about the important events and character response, Mr. Taylor tasked his students to create a digital story in Scratch to represent their understanding. First, he asked students to identify at least three integral episodes within the story. Then, students added the response of characters to each episode selected.

To prepare his students to create a digital story in Scratch, Mr. Taylor selected and presented examples of digital stories representative of the type he wanted his students to create. After each example, his students discussed elements of each digital story and how Scratchers used the available tools to communicate their message. His students also looked inside each program to observe how the coding and tools aligned with the design and content in each digital story.

Once Mr. Taylor's students developed an understanding of how to create their representation of the integral story episodes and character response, they began to work on the task. As students created digital stories, they would continually run through their programs to check script execution, design, and communication of the story. Mr. Taylor conferenced with each student during the design and coding process to assess implementation of the task and provide assistance as needed.

After students completed their digital stories, Mr. Taylor dedicated time in class for everyone to present their digital stories. During the presentation, students discussed why they selected their key events to include in the Scratch product. Mr. Taylor also facilitated discussion regarding how character response to each event was communicated in the digital story. Often, the discussion touched upon the use of modal resources available in Scratch to portray character response. Once the project was completed, Mr. Taylor invited his students to publish their projects on Scratch to receive a response from the Scratch community.

RPGs in Scratch

The incorporation of role-playing games (RPGs) in Scratch provides another opportunity to expand upon the literacy experiences of early adolescent gifted, talented, and creative children. An RPG is a game in which players assume the role of a character within a fictional setting. In Scratch, players contribute to the narrative of an ongoing story by providing storylines within the comment section underneath the project. Players add character sheets within the RPG's project page. Often, the RPGs played within Scratch are based on texts favored by the players (Kafai & Burke, 2014). Examples of favored texts include the *Harry Potter* series by J. K. Rowling and the *Warrior Cats* series by Erin Hunter.

Within Scratch, my daughter engages in numerous types of literacy experiences focused on her appreciation of the *Warrior Cats* series. Jessica contributes to online discussions focused on *Warrior Cat* characters and clans. She views digital products and reads scripts created by Scratch members. Jessica also leaves feedback for the creators of *Warrior Cat* products to read. Currently, Jessica is active in an RPG called *Clans of the Starlit Forest*. She serves as one of the three RPG managers. The narrative is focused on four clans of cats who negotiate four territories of varying climates. Each player has created a bio sheet comprised of character skills, personality traits, rank, and clan information. Players take turns writing text based on their created character to move the story forward. The narrative ranges from basic statements to complex prose. A total of 143 players have contributed more than 8,500 comments to the RPG. Jessica's most recent contribution to the narrative includes,

> Dovestar sat, perched on the high-branch watching the rain fall down heavily, it was another dreary Leaf-bare day and everybody was tense and ready for battle. Dovestar hoped as soon as the storm had cleared up she could check on her Allies at Mistralclan. She let out a massive sigh and hopped off the high-branch and padded into her den, shaking off the raindrops on her pelt, she lay down, curling up in the moss.

Fellow players will add to her RPG entry to continue the narrative from multiple characters' perspectives.

A plethora of RPGs exists within the Scratch community. Currently, more than 500,000 Scratch studios have RPG in their titles or descriptions. Engagement in RPG experiences provides early adolescent gifted, talented, and creative children with opportunities for interactive and collaborative storytelling based on personal interest. Research in gifted education suggests personal interest as a significant factor in development of attitudes toward reading and writing (Cavazos-Kottke, 2006; Krause, 2013). The ability to select RPGs based on personal interest combined with literacy practices inherent within the RPG format found in Scratch provide gifted, talented, and creative children with opportunities to practice a variety of literacy skills.

In addition, the format of RPGs found within Scratch act as a community of practice. Lave and Wenger (1991) defined a community of practice as a group of individuals who engage in a process of collective learning and maintain a common identity. The process of sharing narratives within a self-organized learning environment helps members to learn from each other (Kafai & Burke, 2014). This situated practice found within the self-directed community includes both novices and experts working together around the literacy practice of shared authorship. The collaborative nature of RPGs and situated practice within Scratch can be used by gifted educators to provide opportunities for interaction with intellectual and creative peers as well as with typical peers (NAGC, 2010, 4.2.2). The collaboration supported within Scratch helps to develop social competence via positive peer relationships and social interactions within an online space (NAGC, 2010, 4.2.3).

Classroom application

Ms. Alonso is a seventh-grade language arts educator working with a small group of students talented in language arts. Recently, her students completed a literature group focused on *The Glass Sentence* by S. E. Grove. As students discussed the book, Ms. Alonso noticed they frequently engaged in discussion focused on how the author portrayed the essential characters. There was even heated debate regarding why specific characters made certain choices, which influenced the direction of the narrative. Wanting to differentiate curricula to incorporate conceptually challenging and complex content (NAGC, 2010, 3.1.4), Ms. Alonso extended the literature group to create an RPG within Scratch. In addition to exploring complex character development with her students, Ms. Alonso wanted her students to engage in a variety of digital literacy experiences. She also planned to use the RPG to cultivate skills in producing clear writing appropriate to task, purpose, and audience (Common Core State Standards Initiative, 2016, WHST.6-8.4).

First, Ms. Alonso introduced her students to the concept of RPGs. She explained the nature of RPGs and asked students to explore preselected RPGs within Scratch. During the selection of RPGs to explore, Ms. Alonso focused on RPGs representative of the format and writing style she envisioned for her students. As students explored the selected RPGs, they compared and contrasted the format, writing style, and development of the characters in each story.

Next, Ms. Alonso asked her group to identify the essential characters in *The Glass Sentence*. Then, working collaboratively, her students determined a potential story sequence to build upon the conclusion of *The Glass Sentence*. Students were encouraged to consider the next step each essential character would take. Once a general story sequence was determined, students selected a character to represent in the RPG.

To prepare for the RPG, Ms. Alonso created a studio in Scratch. After she added her students to the studio as curators, they were able to contribute items and create the RPG. Students used the available tools in Scratch to create character sheets, which provided a visual representation and description of the characters portrayed in the RPG. Some students chose to also animate their characters to provide an introduction for Scratchers visiting the studio.

After the character sheets were added to the studio, students engaged in the RPG using the created story sequence as a guide for the narrative direction. Each week, a student would assume the role of the RPG director. The director was responsible for keeping the narrative focused on the story sequence and facilitating the weekly in-class meeting to discuss progress and character development. During this meeting, students would discuss character development in the RPG and the direction of the narrative. Although time was provided in class to work on the RPG, Ms. Alonso noticed her students often contributed to the RPG after school.

Scratch Across the Curriculum

Due to the versatility of Scratch, educators can easily differentiate experiences for gifted, talented, and creative learners (Coxon, 2012). The decreased constraints afforded within Scratch provide educators with an open platform for students to create self-directed learning experiences. Providing opportunities for self-directed learning in areas of interest and talent is a key component in meeting the needs of gifted, talented, and creative students and has a positive effect on motivation to learn (Thomson, 2010). Students become agents of their own learning (Bandura, 2006; Mudrak & Zabrodska, 2015).

For example, within the larger domain of giftedness, O'Brien, Friedman-Nimz, Locey, and Denson (2005) argued for the consideration of computer technology as a talent domain. Children with a proclivity toward ICT may be talented in programming, interfacing, or both aspects of ICT (O'Brien et al., 2005). Programmers are children who enjoy working alone with computer language while interfacers like to help others with technology problems. The Scratch environment is designed to nurture both types of ICT talent. Programmers experience unconstrained ability to create code as they design a variety of programs. Interfacers are able to immerse themselves within a community of practice by which they can position themselves to mentor fellow Scratch members. Scratch provides opportunities to nurture students talented in ICT (Kafai & Burke, 2014).

Scratch is also used to develop interdisciplinary curricular concepts. For example, students complete a visual guide to sharks in Scratch, which combines science, technology, and principals of art and design. Educators of gifted, talented, and creative students can use the medium to provide interdisciplinary curriculum materials in an engaging format. Content is made more meaningful via the use of Scratch to produce student-created curriculum-based digital products (Kafai & Burke, 2014; Lee, 2011).

An example of using Scratch to support mathematical concepts can be found in my daughter's gifted education classroom. Students were asked to create a math project based on concepts recently learned. Initially, Jessica began to work on a paper-based project; however, she struggled to creatively communicate what she learned about graphs. After sharing her concern regarding creativity, Jessica's gifted teacher suggested creating her project in Scratch. Jessica chose to develop a math bulletin board (see Figure 2), which included a tutorial on the graphing concepts learned (see Figure 3) and a quiz (see Figure 4) for Scratchers to take. After earning a grade, Jessica chose to publish her math bulletin board in the Scratch community.

The example provided above is an illustration of how Scratch was used to differentiate for the needs of a gifted student (NAGC, 2010, 3.3.2). Jessica was afforded a medium to create a curriculum-based product that allowed her to communicate her ideas in a creative, yet academic, way. Interestingly, Jessica received comments from Scratchers providing positive reviews of her work. One member stated, "That's really good! I love all ur [*sic*] projects" while another member shared, "awesome, u [*sic*] should do more." Member feedback received further supports agency and provides motivation to continue creating digital products in Scratch (NAGC, 2010, 4.2.2).

ScratchEd

Much is currently made of the affordances of Scratch within organized classroom work. ScratchEd (http://scratched.gse.harvard.edu) was created in 2009 to assist educators with implementation of Scratch. Within ScratchEd is an online community for educators to share stories, exchange resources, ask questions, and find people, thus scaffolding integration of Scratch into classroom environments. Scratch takes advantage of networking and shared development to increase the effectiveness of individual teachers (Fincher & Utting, 2010). Educators of gifted, talented, and creative children network to share ideas and resources regarding the use of Scratch with

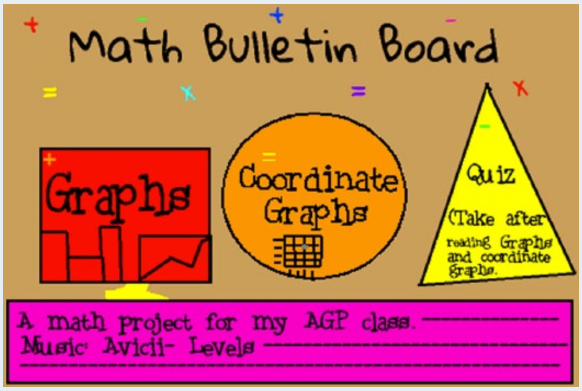

Figure 2. Cover screen for the graph project.

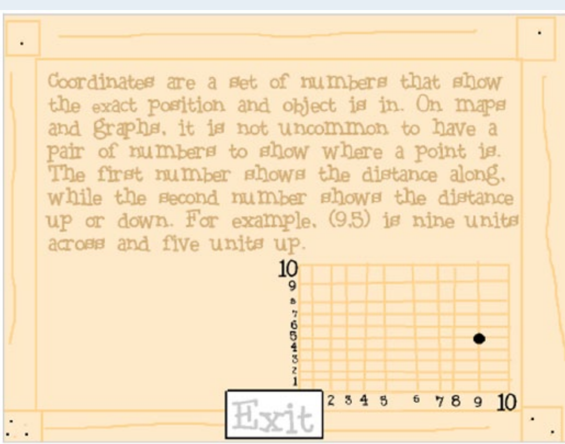

Figure 3. Example of a tutorial screen.

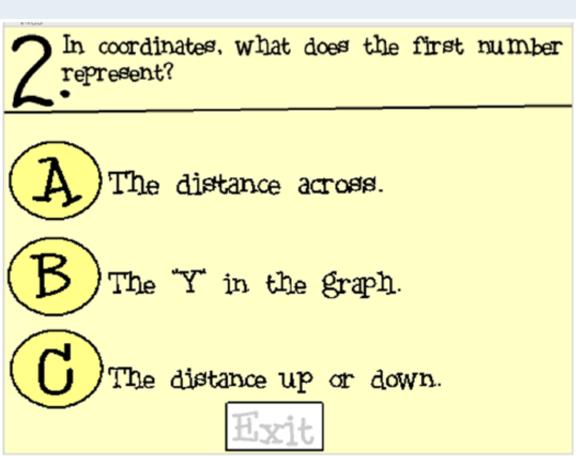

Figure 4. Example of a quiz question.

their students. But the use of Scratch for curricular work is not automatic. It is important to note explicit instruction should be provided when attempting to integrate course content into Scratch experiences. Moore (2013) provided an example of a teacher with an ambivalent experience encouraging fifth- and sixth-grade students unfamiliar with programming to develop their own video games while integrating current events. Upon reflection, the instructor believed his lesson was too unstructured, and the resulting learning experience was uneven for students. Although Scratch is intended as an entry point for children to learn programming, educators need to provide explicit instruction related to its application of specific course content into Scratch programs.

Conclusion

Early adolescence marks a pivotal time for learners. When crafting educational experiences, it is important for gifted educators to consider how to provide tools for creative productivity. The low floor and high ceiling found within the design of Scratch provides a medium for gifted, talented, and creative students to engage in and explore the use of programming to create products based on interest and talent. The ability of students to engage in self-directed learning experiences helps to develop a sense of agency and increases motivation to learn. In addition, Scratch provides a community of practice whereby students are motivated to engage in situated practice with community members. The use of programming to create digital products taps into the natural desire for children to tell stories and share their understanding of the world. Scratch provides an environment for children to explore and develop deeper literacy practices via the design and redesign of multimodal products. The versatility of Scratch also helps gifted educators to differentiate experiences for learners.

Traditional conceptualizations of literacy as reliant on print forms of text are outdated and unresponsive to the dynamic changes of the 21st century. While it is important to embed traditional literacy experiences into instructional practice, educators must also balance instruction with a variety of digital literacy experiences. Scratch is an ideal tool for creating situated digital literacy experiences in addition to providing a space with unlimited potential for creativity and talent to emerge. In addition, Scratch can be used to develop interdisciplinary curricular concepts. Scratch enables students to become active producers of knowledge rather than passive receivers. The ability to program widens the range of what can be created and self-expressed, while expanding what can be learned.

Epilogue

Due to her positive experiences with Scratch in her gifted education program, Jessica continues to use programming to create digital products to express her creativity and interests.

Recently, my daughter excitedly shared that a project she created on Scratch was selected as a featured product. It is considered a high honor to have a project selected by the Scratch Team to be included in the Feature Projects section of the home page. Since being featured, Jessica's project titled *Grace's House* has received more than 28,000 views, 2,898 comments, and been remixed 73 times. The strong response received from members of Scratch via the number of views, comments, and remixes affirmed Jessica's ability to create products in Scratch, which in turn motivated her to continue with self-directed literacy experiences. The community of practice inherent in the Scratch environment provided a space for her to interact with members regarding her featured project. In fact, she took great care to respond to each member's comment and even created a separate project to document member suggestions. Her experiences in Scratch strengthened her sense of agency and provided motivation to continue her engagement in self-directed literacy experiences found within Scratch.

Notes

Caching

To store data in a temporary storage area with the intention of using the data for a future function. Caching helps to increase programming speed by creating quick access to data required to complete a specific task.

Coding

The process of applying a system of symbols to represent letters or numbers. The symbols are used to execute a computer program.

Computational thinking

An approach toward solving problems, designing tasks, and understanding behavior that draws upon computer science concepts.

Interactivity

Communication that occurs between a human and a computer program. Interactivity embedded within a computer program requires communication to occur between the computer and the human interacting with the program. For example, computer games that require human input contain interactivity.

Modularization

A programming technique focused on creating independent, interchangeable modules. Each module contains everything required to execute a specific aspect of the program.

Prefetching

A strategy used to speed the process of programming. Data are collected and stored in advance with the expectation that they will be used while creating a program.

Programming

The process of entering code into a computer that leads to an original formulation of executable programs. The purpose of programming is to create a set of instructions resulting in an automated sequence to complete an identified task or solve a specific problem.

Script

A specific code sequence that automates a task or series of tasks.

User interface

The visual part of a computer program through which a user communicates with a program. An interface is comprised of a set of commands or menus to facilitate human–computer interaction.

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Bio

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