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Vygotsky Meets Technology: A Reinvention of Collaboration in the Early Childhood Mathematics Classroom

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Abstract With the advent of Web 2.0, Vygotsky's traditional role of the more knowledgeable other (MKO) has been transformed. This transformation shifts the power of a facilitator of learning from an elite group of MKOs to all students. Such a transformation possesses significant value in the early childhood mathematics classroom where collaboration is essential for student learning. This article reveals three distinct MKOs that have emerged from the WEB 2.0 expansion, and discusses three tools that usher collaboration and empower students in an early childhood mathematics classroom: Voki, VoiceThread, and Vodcasts.

Keywords Vygotsky · VoiceThread · Voki · Vodcasts · Mathematics · Early childhood · Educational technology · Elementary

Introduction

The international education community's high regard for collaboration as instructional practice has transformed the term into a buzzword in the education world. However, introducing collaboration into the classroom often poses a challenge for educators (Andrews and And 1994; Harker and Harker 2007). A position paper written jointly by the Division for Early Childhood Education (DEC) and the National Association for the Education of Young Children (NAEYC), which is also supported by NAEYC's affiliate the Association for Young Children Europe, highlights technology's role as facilitator and conduit in optimum instructional practices. "Technology can enable children with a range of functional abilities to participate in activities and experiences in inclusive settings" (DEC/NAEYC 2009, p. 3). It is at this intersection where collaboration and mathematics meet, that a simple question resides: How can early childhood educators promote collaborative learning in the classroom? The simple answer is technology.

In the contemporary workplace, adults frequently are expected to confer with colleagues, sharing their inner thought processes with peers. Instances of this can be seen across workforces. Consider, for example, how members of a robotics team might analyze the sensor data, brainstorm programming sequences, and develop algorithm options for complete automation; how a group of architects draft plans, discuss alternatives and select necessary adaptations to the final project layout; or how a carpentry team would discuss puzzling angles within a sketch, devise aesthetically pleasing alternatives, and build the custom order. Collaboration is a powerful tool that aids in deliberate decisions and forms effective strategies. It is so powerful that Vygotsky's theory of learning necessitates social activity (Vygotsky 1978). In 2007, The Association for Childhood Education International (ACEI) compiled a list of standards for ACEI educators. Five of the standards consider instructional practices and collaboration is emphasized; in fact, the final standard is: "Communication to foster collaboration—Candidates use their knowledge and understanding of effective verbal, nonverbal, and media communication techniques to foster active inquiry, collaboration, and supportive interaction in the elementary classroom" (ACEI 2007, p. 1).

This article begins by examining the implications of Vygotsky's sociocultural theory for early childhood

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curriculum. Then it examines how instructional technology increases socialization and collaboration among early childhood classmates in the content area of math. Finally, practical instructional technology programs that promote collaborative learning and mathematics mastery in the primary grades are explored and analyzed.

The More Knowledgeable Other: The Benefits of Reinvention

Lev Vygotsky's social developmental theory includes the zone of proximal development that relies upon the more knowledgeable Other (MKO). Vygotsky (1978) defines this MKO as an essential component of the learning process and defines it as someone with more knowledge or a greater understanding of a particular task or process than the learner. Decades later, educational research still supports his theoretical stance: socialization and collaboration play a vital role in learning (Fawcett and Garton 2005; Gooch and Saine 2011). Educators often identify the MKO as an advanced peer or an adult in the classroom; the advent of the internet did not alter this limited perception. This stagnant view of the MKO remained limited due to Web 1.0's limitations.

The Internet has emerged in two stages: Web 1.0 and 2.0. The comparatively stagnant and passive activities associated with Web 1.0 are far from the diverse, interactive activities that occupy students' time in the year 2013. The interactive and collaborative Internet that existed after 2004 is commonly referred to as Web 2.0, an improved version of the Internet. While Web 1.0 offered students immediate access to information it offered no opportunities for interaction. This can be attributed to the need of precise programming or html knowledge for sharing information across the Internet during its Web 1.0 stage. As students, understandably, lacked these technical prerequisite skills the MKO role maintained its typical structure. To clarify the immense difference between the power that accompanied Web 2.0's emergence consider the following contrasts. Web 1.0 offered students resources for finding information such as online encyclopedias. Through this platform students could learn about a culture from across the globe by clicking on a keyboard. Web 2.0 transformed this typically passive role of the learner and enables students to become fully immersed in the culture through the use of interactive geographic maps, live communications with students living in the country, and uploads of video or audio creations reflecting their own understanding of the cultural customs. They could even take that Web 1.0 online encyclopedic site and add new information or share new insights. With the transition from a read only Web 1.0 platform to the interactive Web 2.0 platform, capabilities of web-based programs are expanded. Web 2.0 transcends the act of simply receiving information from the internet and enables users to interact with internet content and internet users. The space acts as a medium for social learning. Anttiroiko and Savolainen (2011) stress Web 2.0's essential distinction from Web 1.0. "Thus, enhanced interactive functionality is one of the major characteristics of Web 2.0. Web 2.0 allows users to generate, describe, post, harvest, search, annotate and exchange online content in various forms ranging from music and photographs to bookmarks and documents" (pp. 88–89). Gone are the days of the traditional use of technology as a tool for one-way information transference. Technology now transcends its previous isolative barriers and acts as a conduit for collaborative learning –simultaneously transforming typical students into their peers' more knowledgeable others (MKO). In the pre-twenty-first century classroom the MKOs were most often teachers or advanced classmates.

Web 2.0 has dramatically increased the opportunities for learning from a more knowledgeable other. In some cases today's MKO is a computer adaptive math program that creates an individualized tutoring series for students based on which incorrect answer they select; in other cases the MKO happens to be an introverted child in the same small school that confirms a peer's thought processes and extends a theory's life by providing an additional proof. In still other cases, MKO is a student halfway across the globe explaining word problem solutions by drawing images to correspond with tables.

Antonacci et al. (2008) identify three significant benefits of using virtual worlds as collaborative learning environments that clearly correspond to the necessity of the three MKOs discussed above. First, they found that the virtual world allows students to complete tasks that would otherwise be improbable due to realistic constraints, including money and time (Antonacci et al. 2008). The newest and rarest MKO, a computer adaptive program, allows for individualized instruction without the financial constraints of hiring additional salaried teachers. This introduction of a program as an MKO is novel. A recent study of kindergarten children in Turkey revealed that students with a math Computer Aided Education mastered number and shape concepts more successfully than their peers in the traditional education classroom. The academic growth between pre-test and post-test proved statistically significant for the experimental group receiving Computer Aided Education. Many programs, including iStartSmart and Children's Progress Academic Assessment, offer early childhood educators options for Computer Adaptive Program where individualization, differentiation, and scaffolding are programmed into the software.

The second benefit that Antonacci et al. (2008) identified is the virtual world's persistence and constant accessibility which increases social interactions and therefore provides more opportunities for collaborative learning. The anonymity and comfort that virtual worlds provide students can transform a shy, quiet student into a powerful MKO and peer coach. Socially withdrawn and anxious students often have difficulty collaborating or even socializing with peers (Kingery et al. 2010). This strength of virtual collaboration was especially powerful for a group of kindergarten and first grade classes in a Midwestern town in the United States. Children experienced a shift in role from typical observer to leader (MKO) when using *Pix Studio Deluxe* to collaborate with classmates (Chung and Walsh 2006).

The third benefit of utilizing virtual worlds for collaborative learning that Antonacci et al. (2008) discovered focuses on the adaptive and emergent nature of virtual worlds. The researchers cite activities online as ones that demonstrate high cognitive functioning including creating, analyzing, and evaluating. This third benefit is especially powerful when the most overlooked MKO is evaluated, the child that is often labeled as low-achieving. In a 2010 study of Canadian students, Moss and Beatty identified that lower-achieving students who rarely participated in math discussions posted more notes on a virtual learning blog than other students. These students were blogging with students whom they did not know, and the virtual world's ability to erase the stigma of low-achievement had a significant effect on participation, collaboration, and success.

As the more knowledgeable other role shifts to include more peer collaboration, teachers' roles are changing as well. In 1998, one year after the internet housed a record of one million websites, Schneidermann recognized the necessary paradigm shift of teachers to become facilitators of learning rather than simply sources of all information. A decade later the role of facilitator is even more essential as student-driven learning flourishes. Samuels (2010) poignantly summarizes what current mathematical pedagogy should entail stating: "It involves collaborative student-led project work using integrated hardware and software in a Web 2.0 content sharing laboratory environment" (p. 197). Considering that technology is an essential component of students' lives, the notion that instructional technology increases opportunities for peer collaboration is apparent (Oblinger 2008; An and Reigeluth 2011). Students are often referred to as "digital natives", and it is due to technology's entwinement with their lives that virtual collaboration possesses such power (Prensky 2007).

The American Psychological Association (1997) identifies fourteen learner-centered psychological principles and distinguishes collaboration as a key component in student learning stating: "Social influences on learning. Learning is influenced by social interactions, interpersonal relations, and communication with others" (p. 5). While the importance of collaboration has remained strong over the years, the world of today's students has changed, growing massively through bitmaps and bandwidth. Facilitating collaboration through their medium of choice, the virtual world, enables students to cross the boundaries of content area, countries and grade levels. These aspects of the internet make collaborative learning activities extremely effective. According to (An and Reigeluth 2011) "learning activities are often global, interdisciplinary, and integrated"(p. 55). The internet creates an environment where these effective learning activities thrive.

While students have revolutionized the role of the more knowledgeable other, teachers must respond with deliberate facilitation practices. Rosen and Nelson (2008) suggest three aspects of virtual collaboration that aid in facilitation of learning including: student-initiated publishing and sharing, utilizing privacy controls and creating pairs, small groups, or whole group activities based on objectives and projects, and allowing students to interact through teacher-selected social network sites. Benford et al. 2000 distinguish encouraging collaboration from enabling it; the former being greater in effort and results. By thoughtfully organizing virtual collaborative opportunities, teachers can aid in efficient and effective learning. In an effort to increase student-driven instruction and collaboration while simultaneously decreasing the typical initiation-response-evaluation interaction between students and teachers, select Singapore primary schools piloted the Group Scribbles program (Chen and Looi 2011). Group Scribbles is a virtual learning environment that provides students with two areas of space: a private board and public board. This format enables students to work privately on one section of the interface while simultaneously viewing what classmates have uploaded to the public section. Allowing classmates to move private board scribbles and ideas to the public board increases the diversity of ideas in the classroom. The process seems to flawlessly create a private metacognitive thinking space and a public collaboration space in a single virtual environment. After introducing this program, researchers found high levels of collaboration along with increased participation, increased idea diversity, increased peer interaction, and increased peer formative feedback. They also identified that the virtual program created an environment that encouraged improvable ideas, thereby increasing negotiations and idea refinement (Chen and Looi 2011). Shifting the more knowledgeable other role from teacher to student was certainly the objective in this pilot, and the results clearly support that virtualization aids in this effort.

While Vygotsky's role of the more knowledgeable other is traditionally portrayed as a teacher, paraprofessional, sibling, or advanced classmate, technology allows for a new definition to be written, one that celebrates students driving their own instruction with masterful guidance from teachers.

Socialization and Collaboration: Technology's Role

As socialization is a major goal of early childhood education (Essa 2002; Wang et al. 2010) it is understandable that some skepticism originally surrounded the introduction of technology into the early-childhood classroom. As discussed, collaboration often results in the use of higher cognitive processes. These higher order thinking practices are essential in early childhood mathematics. In the year 2011 the targeted percentages of mathematics cognitive domains by Trends in International Mathematics and Science Study are identical for fourth and eighth grade students under the domain of 'applying'. Specifically, students in fourth and eighth grades are expected to have 40 % of their testing time in mathematics focus on the application of knowledge (IEA 2012). While discussions of elementary and intermediate education concerns are rarely central to early childhood educators, NAEYC deemed this struggle in content knowledge of older students as a cause for concern in early childhood. Their 2009 position statement "NAEYC Standards for Early Childhood Professional Preparation Programs" revised these standards with a stronger attentiveness to content education. Standard Four was separated into two standards (Four and Five). Standard Four focuses solely on methodology while Standard Five emphasizes content. Students must inhabit Bloom's higher levels in early childhood mathematics if they are expected to perform proficiently on application and reason based assessments by age nine. Peer collaboration promotes higher order thinking skills including: creating, evaluating, analyzing, and applying (Valcke et al. 2009). The use of educational technology is not a solitary practice. In fact, the International Society for Technology in Education (ISTE) has created National Educational Technology Standards (NETS) that clearly highlight technology's role in fostering collaboration. Figure 1, *Crosswalk of ISTE NETS Standards and the social aspects of technology,* illustrates that of the six NETS Profiles over half of them concentrate on social aspects of technology. Profile Two focuses solely on communication and collaboration (ISTE 2007). Profile Two states: "Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others" (ISTE 2007 p. 2). ISTE's Pre Kindergarten through Grade 2 suggested experiences include the terms 'communicate', 'collaborative work group', and 'demonstrate' multiple times, while the term 'independently' only appears once Research supports that these suggested collaborative activities are promoting socialization of students.

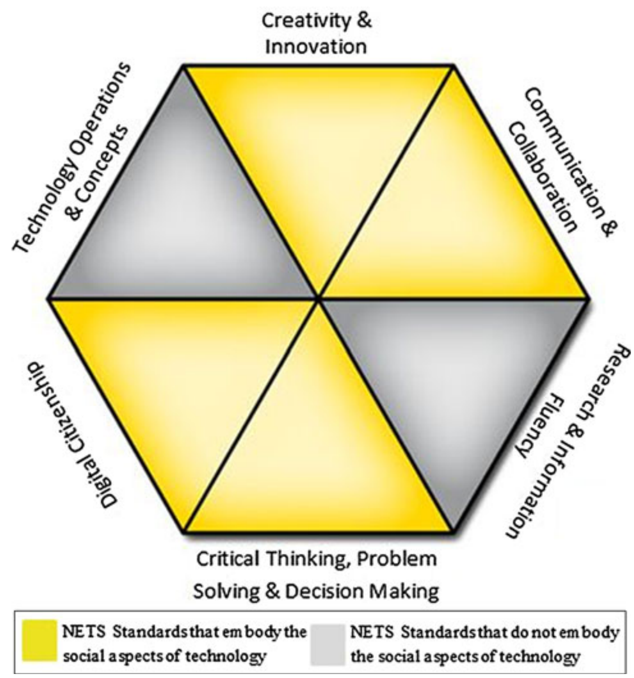

Fig. 1 Crosswalk of ISTE NETS Standards and the social aspects of technology

Specifically Martino's (2007) research supports the claim that creating online avatars aid students in expression with peers that increase their connectedness and improve self-confidence. Avatars are computer created graphics that represent a person online. In some cases the avatar can be designed to look like a human, an animal, or a fantasy character. In a ten-year review of research on virtual reality Mikropoulos and Natsis (2011) identify this transference of socialization between avatars and participants as central to the depth of online learning. This is imperative for students who may not feel comfortable working with peers in the traditional sense. In some cases collaborating virtually acts as a scaffold to collaborating in the physical world (Woolgar 2002). In an effort to attain key learning competencies of the New Zealand Curriculum Framework (Ministry of Education 2007), a virtual authoring tool, MARVIN, was introduced to 995 students in urban New Zealand (Falloon 2010). The primary goal was to support student thinking and relating to others. Findings suggest that use of virtual worlds in communicating and collaborating increased student confidence and willingness to share one's thoughts and work (Falloon 2010). Teachers also appreciated the benefits agreeing that "MARVIN offered an 'idea foil' to build collaborative skills and teamwork, thus supporting the objective" (p. 116). The use of virtual worlds to increase collaboration appears to span across the globe. In a recent study of second grade students in Taiwan, researchers demonstrated that introducing tangible story avatars increased confidence and acted as a platform for shared collaborative work among students (Liu et al. 2012). Because virtual worlds increase students' desire to collaborate they naturally have a positive effect on the practice of higher order tasks that are associated with collaborative learning.

In addition to prompting collaboration from children who are less inclined to work with peers in the traditional sense, virtual collaboration also acts as a haven for students who find it difficult to do so due to cognitive functioning concerns. Abbeduto and Hesketh (1997) identified that children with cognitive delays often have an understanding of information but difficulty verbalizing it, answering questions, and following expected linguistic politeness customs. Peer collaboration can be a difficult task for students with a range of concerns including: cognitive disorders, autism, or learning disorders (Leaning and Watson 2006). While sitting in the computer lab with Jamie, a first grade student with multiple learning disabilities, his paraprofessional, Allison, watched in awe as he collaborated with classmates via VoiceThread. He posted text comments and even voice recordings explaining how he drew dots to answer the addition word problem. Students responded to his metacognitive thought process in virtual conversations as if they were not at all surprised by Jamie's participation. When the aide asked why she was struck with a look of confusion and disbelief, Allison responded "He never works with other students. He just sits in groups silently-even when encouraged." It is important to note that Jamie talks with kids at lunch and plays at recess; he is not a shy boy. However, he often feels overwhelmed and confused when he is presented with many ideas and questions simultaneously. Virtual collaboration offers students a quiet place to think, create, and respond at their comfort level. In an online thread describing how individuals solved addition word problems, students of all abilities discussed their strategies and learned from classmates. The ability of the virtual world to level the playing field by introducing a platform that includes all students is a significant strength.

Armed with technology, teachers can increase collaboration for all students, demonstrating its necessity in *all* early childhood classrooms. Instructional technology's positive impact on pedagogical practices is so apparent that the European Commission allocated funding to train early childhood educators in communications technology in the countries of Bulgaria, England, Portugal, Spain and Sweden (Saude et al. 2005). Similarly, in the United States, a team of researchers conducted a discourse analysis o kindergarten students' talk during technology-based activities. They found that technology increased the amount of talk, talk patterns, collaboration, scaffolding, and purposeful and reflective discussions among classmates (Eunsook and Davis 2005). Technology's role as a catalyst for student collaboration and therefore a medium for higher order thinking, renders international support on the educator and policy level. In an era where early childhood curricula call for "online interaction: global participation, multiuser collaboration, and distributed resources and knowledge" (Wohlwend 2010), p. 147), students are truly empowered to drive instruction, coach peers, and discover the joy of learning.

Voki, VoiceThread, and Vodcasts: Promoting Collaboration Practically

Promoting virtual collaboration is a deliberate choice initiated by priorities and pedagogy. Hew and Brush (2007) identified three major barriers to integrating technology: (1) inadequate resources, (2) lack of institutional support, and (3) content area issues. Addressing these barriers aids in mitigating teacher concerns for utilizing such valuable teaching methods. The institutional barrier: it is clear through the discussed research that institutions throughout the world support utilizing instruction technology applications to increase collaboration in the classroom. The subject culture barrier: as a content area, math was one of the first subjects to allow technology in the classroom. As calculators flooded schools in the 1980s and 1990s, it was not without educator concern, but the calculator's current presence demonstrates technology's usefulness and resilience in the classroom (Banks 2011; Waits and Demana 2001). Furthermore, with the recent emerging trend in STEM (Science, Technology, Engineering, and Mathematics) courses it is apparent that technology and math are fused together. With these intrinsic barriers addressed, a practical solution to the 'resource' barrier must be discussed.

In an effort to gauge the impacts of the global economy on education, Education International analyzed forty-three countries' responses to the survey: The Global Economic Crisis and its Impact on Education (Education International 2012). Survey responses indicate that technology is a priority for many countries; however policymaker priorities are not always quick to impact typical classroom resources. Thankfully the quantity of free, quality web-based programs that foster collaboration is increasing exponentially. Three practical applications that offer platforms on which students and teachers can collaborate in math learning activities are free, user friendly, and engaging. Appropriate use of, Vokis, VoiceThreads, and Vodcasts not only promote higher-order thinking skills (e.g. creating, evaluating, and analyzing,) but also promote peer collaboration.

Voki

Voki is a web-based program in which children bring monologues to life. Young children can design Avatars, digital images that represent a person or character, by choosing from a wide range of Voki options and then add voice narrations to create a unique character. Children can use that character to share thoughts and ideas through typed text, computer microphone, sound file upload, or phone. The Voki technology captures children's attention with attractive graphics, encourages collaboration by providing authentic audiences, and enhances creativity by presenting a large selection of options (Lowe et al. 2010). Voki facilitates creativity and focuses on higher-level thinking skills of creation and evaluation (Anderson and Krathwohl 2001). *Creating* with Voki empowers children to bring their thoughts and words to life through self-created digital avatars with an authentic audience including classmates, parents, and teachers. Figure 2, *Students use Voki avatars to describe scientific experiments to their parents*, demonstrates students illustrating creativity in a math and science lesson. *Evaluating* with Voki empowers student audiences to watch one another's Voki project and invent a responder Voki for feedback that furthers collaboration. Consider the preschool student that creates a Math Wizard Voki to teach classmates patterns, or the first grade students who create Voki Quizmasters, challenging classmates to complete student created addition quizzes, or the second grade Voki teams that solve classmate's word problems while discussing strategy and thought processes. Voki encourages collaboration and creativity while supporting teachers with an extensive lesson plan data base searchable by grade level and subject. The Teacher's Corner coaches teachers through an easily navigated site, offering video tutorials, an FAQ section, and sections designated by user level such as Newbie's Corner and Advanced Corner. While the process of creating Vokis certainly justifies the short time that it takes to make one, the true strength of the program lies in its ability to stimulate a cycle of collaboration. With every new audience member and every new response, the enthusiasm for learning grows. Sharing their thoughts through technology boosts children's confidence and promotes socialization in the early childhood classroom.

Fig. 2 Students use Voki avatars to describe scientific experiments to their parents

VoiceThread

VoiceThread is considered a pioneer of free, collaborative programs. VoiceThread is a free online tool that allows teachers to upload any type of file (video, image, text document, pdf, Excel spreadsheet, PowerPoint, etc.) and then enables students to collaborate on the uploads. Files may differ in format from each other, and one to four files can be uploaded and arranged in a preferred order. In early childhood the upload is usually performed by a teacher who organizes and facilitates collaboration. Once these files are uploaded and arranged, students have a variety of options for collaborating with classmates. Students can choose from typing their thoughts, recording them via an internal or external microphone/headset, uploading a sound file, or calling in from a phone. In addition to these commenting options, VoiceThread includes a Doodle feature shown in Fig. 3, *The Doodler feature in VoiceThread enables students to annotate over pictures, videos, or documents.* As students speak the colored annotations fade. This Doodle feature allows students to annotate over the images, video, text, or presentation as they comment. Annotations fade as students continue to comment, thereby preventing clutter or confusion. The Doodler offers a variety of colors to use when annotating. The variety of comment options and annotations are considered among VoiceThread's strengths as they give students freedom to select tools that work for their learning styles (Brunvand and Byrd 2011). In the 2009 edition of the Horizon Report, VoiceThread is noted as a tool to watch due to the collaborative learning opportunities that it provides (Johnson et al. 2009).

In a recent math lesson, kindergarten students were presented with a three slide VoiceThread. The first slide, an image of five apples on the left side of the screen and eight apples on the right, students were directed to identify which side had the most apples. They deliberated; some students used the Doodler to circle each apple while counting aloud, and other students used perceptual subitizing to identify the greater side immediately. Every student watched and listened to a peer's explanation and responded. The second slide was a thirty-second video clip: a child sat with two piles of wafer cookies. One pile had three 2-inch cookies and one pile had one 2 inch cookie. The child counted the cookies in each pile aloud, and then redirected her attention to the pile with only one cookie. She broke the single two inch cookie into three pieces and asked the students to determine which pile had more, or if

Fig. 3 The Doodler feature in VoiceThread enables students to annotate over pictures, videos, or documents. As students speak the colored annotations fade

the piles were equal. Again students commented, circling and counting in some cases and combatively labeling her a cheater in other cases. The collaboration that appeared during this slide was especially exciting. Six year old students shared metacognitive thought processes in perfectly poignant language, helping classmates understand that amount mattered. The final slide, students' favorite, was a blank document with a bright blue background. Here students were asked to use the Doodler and create a 'greater than or less than' picture problem. Classmates then had the chance to solve one another's creations. While these concepts had been taught in the traditional manner in the classroom, many students left with a better understanding with a better understanding of and increased enthusiasm for math.

VoiceThread also offers a forum where educators can share lesson ideas by subject area, however early childhood examples are scarce. Hopefully, as more teachers use this amazing tool to promote collaboration in their classrooms they will add their lessons to VoiceThread's Digital Library by selecting the 'contribute' tab; it is effortless and worthwhile. VoiceThread provides a free program that fosters collaboration, promotes higher order thinking, and engages students with focused instructional technology. The mathematical discussions that occur at center time and in the lunchroom following a VoiceThread lesson are both inspiring and exciting.

Vodcasts

Vodcasts, the younger sibling of podcasts, are the epitome of social sharing. While podcasts are simply shared audio files, vodcasts are shared videos; the term is an inventive contraction of the words video and webcast. Both tools induce collaboration at every stage: creating, analyzing, evaluating, and responding, and these tech-terms are often used interchangeably. In an effort to examine the effectiveness of podcasting and vodcasting in early childhood education Berson (2009) teamed with her class of preservice teachers to evaluate the benefits and practicality of these tools. The researchers quickly realized that children as young as three enter classrooms with the requisite knowledge to utilize programs like webcasting. Furthermore these digital natives thoroughly enjoy the creative process involved in vodcasts and podcasts (Berson 2009). Naturally, vodcasting and podcasting are free; the only tools necessary are a computer and a camera or microphone.

While in most cases computers come equipped with an internal microphone and camera, the following example of vodcasting comes from a first grade teacher with a twelve year old computer that lacked an internal microphone or camera. Armed with a twenty dollar flip camera, a borrowed school camera, and her cell phone camera, Mrs. Banke facilitated the creation of three vodcasts by 18 students working in small groups during a forty minute math period. Students created measurement estimation lessons using rulers, yardsticks, and measuring tape then created a set of estimation questions for their viewers. The Math Mega Mind team measured objects in the library and cafeteria for viewers and then proposed a new system of measurement- 'The Sallys'. Sally was the tallest girl in class, and she dutifully lay on cafeteria tables, in hallways, and across classrooms to establish an understanding of her height. Then the team posed the following three directives: Estimate the length of the basketball court in 'Sallys', estimate the length of the lunch counter in Sallys, and estimate the length of the principal's SUV in Sallys. Rather than simply providing the answers to these questions, The Math Mega Minds hustled during the last 10 min and videotaped enthusiastic Sally, laying her little body down and measuring each location. Vodcasts certainly offer opportunities for rich, student-driven collaboration, and they also offer truly authentic audiences. Research supports that providing authentic assessments and audiences in early childhood education provides educators with an accurate glimpse of the capabilities of young children (Bagnato 2007; Macy and Bagnato 2010). The possibilities for sharing vodcasts are endless. Vodcasts can be shared by simply uploading the video to a class or school computer; they can be shared through free third party hosts such as Vimeo, Teachertube, or Youtube. They can also be embedded into class webpages or sent to global penpals. Vodcasts are limited only by the users' creativity, and as early childhood educators know a creativity deficiency certainly doesn't exist in the minds of young children.

Conclusion

Vygotsky's research demonstrates the power of collaboration in early childhood education through his social learning theory. When used appropriately, technology leads to a culture of social learning by empowering students of all abilities to take on the MKO role. Resources such as ISTE's NETS offer guidelines for instructional technology in the classroom. Using technology to engage students in collaborative endeavors deepens their understanding of math concepts by offering rigorous learning through relevant projects with authentic audiences. Voki, Vodcasts, and VoiceThread offer children live audience members with whom they can share knowledge and expound insight. As educators prepare the world's future workforce we must strive to foster effective strategies in even our youngest students. Technology simultaneously ushers the tasks of creating, evaluating, analyzing, and applying through collaboration into the classroom while generating greater enthusiasm for learning mathematics.

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