Technology in Gifted Education: A Review of Best Practices and Empirical Research

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Abstract

The article aims to explore the progress of technology use in gifted education and highlight the best practices and empirical research in this area. The literature on the use of technology with gifted students and their teachers has been extensive, with articles on best practices, but the empirical research in this area is still emerging. With the increasing interest and awareness about integrating technology, this review will be useful for helping teachers, practitioners, and researchers understand how technology has been used in different areas of gifted programming, including learning and development, assessment, curriculum, learning environments, and professional development. The authors also discuss the current research on technology use in general education and offer suggestions for future research in this area with gifted children and their teachers. (Keywords: computers, best practices, technology, gifted, talented)

Gifted education began in the United States in the late 1800s but didn't gain momentum until after the launch of the Russian satellite Sputnik in 1957 (Davis, Rimm, & Siegle, 2011). Today, each state in the United States has its own method of educating gifted students, but most states operate using the federal definition of *gifted and talented*:

> Gifted children are those identified by professionally qualified persons who by virtue of outstanding abilities are capable of high performance. These are children who require differentiated educational programs and services beyond those normally provided by the regular school program in order to realize their contribution to self and society (as cited by Davis, Rimm, & Siegle, p. 18).

Technology not only allows teachers to provide differentiated instruction for gifted children and adolescents, but also serves as an educational and creative outlet for some of the best and brightest minds in the world. In this modern era, it is crucial that we have high-ability minds engaged in our most complex technological advancements yet.

Today's students have grown up with mobile phones, computers, and MP3 players (Sheffield, 2007), and it is highly important that their education keeps up with their interests and advancements in technology. The purpose of this article is to evaluate the empirical research related to use of technology with

gifted learners and their teachers. This review will contribute to the technology literature by putting into perspective the research articles in this area using the different strands in national gifted programming standards (National Association for Gifted Children [NAGC], 2010): learning and development, assessment, curriculum planning and instruction, learning environments, programming, and professional development. We chose these strands as the basis for this review because they provide a clear direction for systematic programming for gifted students and have been grounded in strong theory and research practices (NAGC, 2010). Moreover, the Association for the Gifted, a division of the Council for Exceptional Children (www.cectag.org), and NAGC have endorsed these strands' usefulness to gifted programming. We have also highlighted the recent research on technology use in general education and suggested topics for future research in this area for gifted programming.

This review of literature aimed to answer the following research questions:

1. What are some key findings of empirical research on technology use in gifted education?
2. How do the research reports on technology use with gifted students compare with descriptive and evaluative reports in this area?
3. What areas can future research studies in gifted education address to keep up with the technological advancements?

Methodology

For the purpose of the review, we searched online databases, including ERIC, Education Research Complete, Academic Research Complete, and PsychArticles, using a Boolean combination of the following keywords: *computers, technology, gifted*, and *talented*. We used the Pre-K–Grade 12 Gifted Education Programming Standards (NAGC, 2010) as a context to organize the literature. The six strands of the programming standards include learning and development, assessment, curriculum planning, learning environments, programming, and professional development.

We considered only peer-reviewed articles with an empirical research focus and published during the 2000–2012 time period to include in this review. After reading the abstract descriptions of the articles, we shortlisted 23 research articles based on (a) their relevance to the different strands specified in the gifted education programming standards and (b) their focus on the use of technology with gifted students and their teachers. Of the research articles, nine were from journals in the field of gifted education—namely *Gifted Child Quarterly* (n = 3), *Journal for the Education of the Gifted* (n = 4), *Journal of Advanced Academics* (n = 1), and *Journal of Secondary Gifted Education* (n = 1)—and the remaining articles were published in multidisciplinary journals. Eleven of the studies used quantitative methods, seven used qualitative methods, and the remaining five studies involved mixed

methods of data analysis. The majority of the research articles examined the technology use of gifted adolescent students. Table 1 (pp. 156–157) presents a summary of the relevant research studies.

The search process revealed a strong contrast between the number of descriptive articles and the number of empirical research articles, as there were numerous descriptive reports on using technology with gifted learners. As these descriptive and evaluative reports offer a strong base for future research, the Discussion section of this article highlights a comparison of topics in descriptive and empirical research reports to identify gaps in the research literature.

Review of Literature

Technology for Learning and Development

The major themes in the research articles that focused on technology's role to support the learning and development needs of gifted children included an understanding of how their attitudes toward technology can affect their learning (Kahveci, 2010), computer-aided instruction using educational software (Dixon, Cassady, & Cross, 2005; Grimes & Warschauer, 2008), and an understanding of how technology influences their socio-emotional development (Yun, Chung, Jang, Kim, & Jeong, 2011).

Attitudes toward technology. Gifted students should have a developmentally appropriate understanding of their needs and how their beliefs influence their learning and behavior (NAGC, 2010). In a survey on the attitudes of gifted high school students toward technology usage (Kahveci, 2010), the majority of the participants reported that using technology was very relevant to their learning and that they used technology tools regularly in their everyday lives. Students in lower grades were more satisfied with using technology for learning than those in higher grades. When questioned on their confidence with using technology at an advanced level, female students reported lesser confidence than male students. However, all the participants indicated that they would not feel discouraged to let others know if they performed well in technology use and reported high interest in problem solving using technology.

Computer-aided instruction. Dixon et al. (2005) examined whether using computer tools helped to improve gifted adolescents' critical-thinking skills and quality of writing. They compared the critical-thinking abilities of gifted adolescents in two types of writing samples: handwritten and computer-typed essays. They found that using computers was more effective for gifted boys, as they showed an 83% increase in the number of words in their computer-typed essays when compared to their handwritten essays. The authors suggested that the benefits of software for gifted boys were speed and efficiency. Consistent with the majority of research regarding girls' inclination toward English and language arts, gifted girls scored better than

Table 1. Summary of Research Articles Reviewed

Author (Year)	Participants	Methodology	Focus
	Learning and Development		
Dixon, Cassady, & Cross (2005)	99 gifted adolescents	Mixed methods	Writing and critical thinking
Grimes & Warschauer (2008)	35 teachers and 878 elementary and middle school students	Mixed methods	Use of laptops
Kahveci (2010)	158 gifted high school students in a special school in Turkey	Quantitative	Student attitudes toward computers
Yun, Chung, Jang, Kim, & Jeong (2011)	22 gifted adolescents and 24 average peers in a controlled lab setting to play an online game called Ultimatum	Quantitative	Game called Utimatum for social skills
	Programming		
Chan, Hui, Dickinson, Chu, Cheng, Cheung, & Kwai-Man Luk (2010)	29 high school gifted students in Hong Kong	Mixed methods	Online enrichment program
Gentry, Flower, & Nichols (2007)	20 middle school students	Qualitative	Individualized textbooks
	Learning Environments		
Blair (2010)	7 middle and high school students and their parents	Qualitative	Online course
Bohmova & Rostejnska (2009)	15 high school students in Czech and Slovak Republic	Qualitative	Online course
Gadanidis, Hughes, & Cordy (2011)	32 middle school students from a rural school	Qualitative	Online discussion forum called Idea Construction Zone (ICZ) forum
Ng & Nicholas (2010)	10 gifted adolescents from Australia, Malaysia, and UK	Qualitative	Online course
Olszewski & Lee (2004)	99 honors and 85 AP students	Quantitative	Online course

Assessments			
Calero, Garcia-Martin, Jimenez, Kazen, & Araque (2007)	47 elementary-aged children, including 24 gifted	Quantitative	Self-regulation and concentration test
Cope & Suppes (2002)	103 gifted adolescents	Quantitative	Computer-based assessment
Steiner (2006)	50 elementary aged children, including 25 gifted	Quantitative	Space Race game to assess strategic thinking
Curriculum and Instruction Planning			
Dove & Zitkovich (2003)	24 gifted elementary students	Mixed methods: survey and open-ended questions	Inquiry skills in science
Duda, Ogolnoksztalcacych, & Poland (2010)	4 gifted adolescents	Qualitative	Critical thinking in math
Gentry (2008)	136 sixth grade gifted students	Quantitative	E-publishing
Greene, Moos, Azevedo, & Winters (2008)	98 middle school students	Quantitative	Hypermedia
Igo & Kiewra (2007)	43 high-achieving students from a southeastern university	Quantitative	Note-taking software
Liu (2004)	155 sixth grade students	Mixed methods: assessment, survey, observations and interviews	Hypermedia
Professional Development			
Bangel, Enersen, Capobianco, & Moon (2006)	12 undergraduate teacher candidates	Qualitative : interviews and class-room observations	Teacher attitudes
Shaunessy (2007)	418 teachers of gifted in elementary schools	Quantitative: survey research	Teacher attitudes

the gifted boys in handwritten essays. However, when they used computers to write their essays, the gifted boys were able to score similar to the gifted girls. Grimes and Warschauer (2008) believed that allowing students to use laptops at both home and school has the potential to bring useful resources to the student instead of students going to the labs for a part of the school day. In their study, using laptops facilitated project-based learning and resulted in an increase in student initiative. None of the gifted learners reported that laptop use hindered their learning, whereas 97% reported a positive learning experience.

Technology to meet socio-emotional needs. Helping students become fully aware of social and emotional needs is crucial to their overall development. For the past decade, the increasing use of e-mail, chat, and blogs has influenced the experiences that gifted students face. Yun et al. (2011) used an online game called The Ultimatum to determine if gifted adolescents lacked in their social and emotional skills. This game is a decision-making game with two players—one who offers money and another who either accepts or rejects the offer—with a goal of earning more money. Gifted students were better than the average students in strategic decision making but lacked in the social aspect of the game, where they had to cooperate with the other player to earn more money in the game. They earned lower than their average-ability peers, as they were more sensitive to unfair money dealing in the game.

Technology and Assessments

Three types of assessments have a huge impact on the success of a gifted program: assessments for identifying gifts and talents, ongoing assessments of student learning, and assessments that evaluate a gifted program to help meet the needs and strengths of gifted students (NAGC, 2010).

Computer-based assessment can be a great alternative to self-reports. Steiner (2006) used a computer program called Space Race to assess strategic thinking of gifted elementary students. The gifted students showed more sophistication in their strategic approach to playing the game and relied on high-level strategies even when lower strategies were equally effective. In another study, Calero, Garcia-Martin, Jimenez, Kazen, and Araque (2007) studied self-regulation efficiency of gifted students using a computer-based task, Self-Regulation and Concentration Test (SRTC). The computer game analyzed how students resisted distractions and temptations on the computer screen to stay focused on the task at hand. The elementary-aged gifted students in this study showed greater inhibition of distraction, larger memory capacity, and more self-motivation while working on the task. Online assessments were also effective for gifted high school students when Cope and Suppes (2002) examined the use of computer-based assessments with those enrolled in online courses. Such assessments allowed the instructors to analyze how much time their

students took to complete their assessments, and whenever a student spent more time on a particular section, they could analyze the data and help the student to understand difficult concepts.

Curriculum and Instruction Planning with Technology

Common themes on using technology in the curriculum included differentiating instruction to equip gifted students with 21st century skills, such as inquiry skills (Dove & Zitkovich, 2003), problem-solving skills (Liu,2004), critical thinking (Duda, Ogolnoksztalcacych, & Poland, 2010; Gadanidis, Hughes, & Cordy, 2011), and self-regulating skills (Greene, Moos, Azevedo, & Winters, 2008), and for scaffolding their learning (Gentry, 2008; Igo & Kiewra, 2007).

The findings from a study focusing on math curriculum (Duda et al., 2010) recommended that the use of technology should facilitate open-ended problem solving that allowed students to think critically. Gifted adolescents in this research worked with graphing calculators and emulator programs to solve equations. The use of graphing calculators also allowed the students to explore new concepts unfamiliar to them and helped them obtain a concrete understanding of math theories and problems. Another study (Gadanidis et al., 2011) reported similar findings: Middle school students who participated in short math program were actively engaged and enthusiastic when they worked with online plotting programs. The students were eager to share their results with each other. The digital drawing tool allowed students to express their math understanding visually. One example that Gadanidis et al. noted was how a student related a drawing of a side view of an open book to a semicircular prism.

Use of technology in science curriculum (Dove & Zitkovic, 2003) was also effective, as gifted elementary students in the classroom were highly proficient in using mobile communication tools. In this project, children used digital cameras and palm-held computers as they worked through five workstations set up to learn about the environment. Educational technologies were used not only to improve the gifted students' inquiry skills, but also as scaffolding tools. The authors noted the need for proper training, as the students performed better with technology tools for which they were given prior training. In another social studies classroom, Gentry (2008) found that e-publishing was effective for young students for creating student-authored books. All students showed improvement in their assessments, and gifted students improved the most. With the increasing use of Internet resources for referencing and taking notes for class assignments, in a similar study, Igo and Kiewra (2007) aimed to study how high-achieving students used note-taking software to perform "copy and paste" note-taking from online resources. Even when there was no restriction on the amount of text they could copy and paste, they were selective in what information they used from the Internet for note-taking.

Two studies explored the hypermedia learning environment. Liu (2004) explored the use of hypermedia technology by sixth graders in a problem-based learning (PBL) environment. PBL is a student-centered learning approach that insists on authentic learning and solving problems in a real context to improve higher-order thinking skills (Liu, 2004). One of the main issues that students face when participating in PBL is the need for scaffolding. As hypermedia can provide information in different and rich media formats, Liu was interested to find whether this technology could be used as a scaffolding tool to encourage students to solve problems. The gifted students enjoyed working in a hypermedia environment and reported positive attitudes regarding learning with a computer. The results did not indicate any difference in attitude or performance of gifted boys and girls. Another study by Greene et al. (2008) assessed if and how gifted students differed in their use of self-regulation (SRL) strategies. The authors considered hypermedia an environment where students can learn in a nonsequential manner to meet their personal goals for learning. The gifted students in this study used high levels of self-regulating strategies as they summarized information in their own words and were able to coordinate relevant information.

Programming with Technology Tools

Gifted students should be provided with a variety of programming options, such as acceleration, enrichment, and individualized learning opportunities through independent study, mentorships, internships, and online courses (NAGC, 2010).

To attract gifted students to pursue careers in engineering education, Chan et al. (2010) recommended online engineering outreach programs for gifted students, especially for those from remote regions. Most of the students surveyed felt that the online enrichment program fostered higher-order thinking skills and social skills. Although they rated the guidance of their online mentors as helpful and inspiring, they wanted more face-to-face meetings with mentors. Ninety percent of the participants were males, and the need to encourage female students to pursue interests in STEM areas was noted. Individualizing learning is crucial to keep gifted students engaged and challenged in the general classroom. Gentry, Flower, and Nichols (2007) studied the use of technology for individualizing textbooks and what gifted students expected of their textbooks. The students preferred using the Internet along with the textbooks to enhance learning.

There is clearly a need for more research studies on special populations of gifted students, including twice-exceptional learners, gifted girls, and rural gifted students. In one study on rural gifted students with motor impairments, Belcastro (2005) pointed out that the lack of services available to these students was due to various barriers, including geographic location, sparse population, differing labor needs, and inadequate teacher preparation. Belcastro advocated for electronic technology as the solution to these

various barriers. Computers connected to the Internet were great equalizers, because they made the outside world more accessible to rural gifted students with motor impairments. Belcastro noted that the funding for computer systems and the cost of training teachers and students were important considerations in implementing effective electronic technology for rural gifted students.

Technology in Varied Learning Environments

An effective learning environment for gifted students should be learner centered, encourage independence and innovation, offer various grouping options, and be flexible (Nugent, 2001). Studies on the effectiveness of online courses have reported several benefits for gifted learners and positive perceptions about learning online. In a study by Wallace (2009), younger gifted students and their parents were surveyed to examine whether online coursework can be effective for younger students. The younger gifted students indicated strong interest in the subject area of the online course and considered the online course less demanding than older gifted students did. Although these students rated their online instructor as highly helpful, they felt that using the software for online learning was difficult. The final grades indicated that young learners scored well and that the majority reported an increased interest in the subject. The parents of these children were satisfied that the online course was appropriate for their young children. The authors suggested that because teachers could not notice confusion during online instruction, students should be proactive in asking for help.

In a related study, one of the main factors that parents perceived as the benefit of online learning was flexibility (Blaire, 2010). In this study, parents reported that the online courses were flexible, in that their children (middle and high school) could take courses that were not offered in their schools as well as additional courses in their areas of interest, could accelerate through the curriculum as opposed to spending nine months in a traditional classroom, and could attend from home at a convenient time, which allowed the students to explore their other interests. Social aspects of the online classroom that encouraged students to be more open to offer ideas and opinions and interact with like-mined peers from different parts of the country were also deemed important.

Similar positive reactions to online learning were obtained from gifted adolescents. Olszewski-Kubilius and Lee (2004) researched why gifted adolescents preferred online courses and reported several reasons, such as desire to learn more about a particular content area, unavailability of face-to-face courses offered at their school, desire to study at their own pace or to get ahead, ability to gain advanced placement credit, and desire for extra coursework that they could not fit into their regular school schedules. The gifted adolescents liked studying advanced and challenging, self-paced online coursework. However, some students missed personal contact with teachers and peers and preferred

more online or phone interactions. Although they were generally satisfied with the online program, they still wanted to use textbooks and written course materials. The authors noted that these students showed an increase in their Advanced Placement exam scores and recommended that online programs can help these students to set and achieve higher academic goals.

Bohmova and Rostejnska (2009) examined the effectiveness of an online chemistry course for gifted high school students, TALNET Online to Science, and found that properly organized online courses can increase the knowledge and problem-solving skills of these students. The gifted students enjoyed learning online and felt the skills they learned will be useful for their upper-level studies. On their research on identifying the appropriate pedagogy for online learning for high-ability students, Ng and Nicholas (2010) outlined several important features that they observed during their research. Creating a virtual thinking community is possible through online courses, as they offer time to critically think and reflect. However, they found that online courses will be more beneficial if students progress from a structured to open learning environments, as the task completion rate was 75%, compared to just 25% when students were offered a totally open learning experience. They also noted the importance of the teacher's role to facilitate online learning.

Online discussion forums can be integrated in the curriculum to provide students more opportunities to think more deeply. For instance, in their study with middle school math students, Gadanidis (2011) integrated an online discussion forum called Idea Construction Zone, which not only offered a forum for collaborating with text messages, but also allowed students to include multimedia components, such as images and videos. Students also benefited from using editable wikis that allowed them to share their views and give/receive feedback from their peers. Students were actively engaged and eager to share their results with each other. Visual images and videos encouraged more communication.

Professional Development Using Technology

However good a technology tool may be, the effectiveness of the tool on students' learning depends on how well the teachers use and integrate the technology in the curriculum. Today, the Internet has enabled teachers from remote corners of the world to receive help from other teachers all over the world. The International Society of Technology in Education (ISTE) and the National Association of Gifted Children (NAGC, 2010) standards have insisted on the effective use of technology by teachers for all students, especially gifted students. In a survey cited in Shaunessy (2005), a majority of the teachers considered technology to be a powerful tool and reported using technology tools for software applications, cooperative learning, project-based learning, student-created products, inquiry-based learning, and differentiation of instruction. However, in their study on professional development for gifted preservice teachers in teacher education programs, Bangel, Enersen, Capo-

bianco, and Moon (2006) noted that a majority of the participants reported that they were not ready to integrate technology in their teaching. Shaunessy (2005) also observed that 81% of GT teachers reported receiving fewer than 10 hours of technology training in a school year. Evidently, there is a need for more technology training for GT teachers at both teacher preparation programs and in schools. Shaunessy (2007) examined GT teachers' attitudes toward e-mail, Web, and multimedia and what they perceived their students' attitudes toward computer to be. Training in technology was the strongest predictor of their attitudes toward technology. It is also worth noting that graduate coursework did not contribute much to teachers' attitudes toward technology. Shaunessy (2007) suggested that future studies should investigate how, when, and why GT teachers use technology.

Discussion

Technology tools have been used in gifted education more frequently in the past decade and will be even more inevitable in the future. This article aimed to highlight the empirical research in this area using the key strands in Pre-K–12 2010 Gifted Programming Standards (NAGC, 2010) as a context for organizing the research findings. To help structure this literature review, we asked three research questions. The following sections present answers to these questions based on our analysis of (a) research on technology use in gifted education, (b) descriptive and evaluative articles relevant to the topics addressed here (published in gifted education journals during 2000 to 2012), and (c) recent research trends in general education (Maddux, 2009; Maddux, Gibson, & Dodge, 2010; Martin et al., 2011).

Key Findings

The overall findings indicate that gifted students reported positive perceptions about using technology for their learning. Clearly, empirical research on emerging Web 2.0 technologies and their effectiveness with gifted students needs more attention. The current research on technology use in gifted education has primarily focused on the impact of technology tools on student learning in areas of critical thinking and adapting curriculum to make it more challenging (Dixon et al., 2005; Duda et al., 2010; Ng & Nicholas, 2010) . Online learning was one of the prominent topics of interest. Empirical research on online learning has shown them to be effective for both younger and older students (Olszewski-Kubilius & Lee, 2004; Wallace, 2009). Students of all ages equally enjoyed the flexibility and online social interaction (Blaire, 2010). Discussion forums (Gadanidis et al., 2011) seem to play a critical role in online learning, as gifted students reported being able to freely share their views and reflect on their learning. However, students missed personal face-to-face contact with teachers in online classrooms, and there was also a need for scaffolding. Research on special populations of gifted students and technology training for teachers of gifted students was limited.

Limitations of this Review

There are some limitations to the study that should be considered before making conclusive decisions about using technology tools with gifted students. This review did not adequately compare and contrast the effectiveness of specific technology tools for gifted students at various stages of their lives. The limitation was in part due to the scarcity of research studies and the scant spread of empirical studies across a decade of research in this area. Another limitation is the accuracy of classification of the research articles based on the strands of gifted education standards. Although we used our judgment to classify the research articles based on the most appropriate strand of gifted education, some research studies could fit multiple strands.

Directions for Future Research

As mentioned earlier, the number of descriptive articles (n = 159) about technology use in gifted education outnumbered the empirical research articles (n = 24) in this area. Although an elaborate review of descriptive articles is beyond the scope of this article, the intent for this comparison was to identify gaps in the research literature and guide future research based on these descriptive articles.

First, to meet the unique developmental needs of gifted students, more research on addressing their social and emotional needs using technology will be indispensable. Many gifted students are skilled in computer technologies and feel a sense of belonging to the world while browsing the Internet. This helps them to resolve psychosocial conflicts and boost their competence and identity development (Cross, 2004). In fact, terms such as nerd and geek that were once considered derogatory are now viewed more positively as referring to one's expertise with technology (Cross, 2005). On the other hand, Siegle (2010) cautioned about issues that gifted students face as a result of cyberbullying and sexting. Teachers and parents of gifted children should not assume that their children's social and emotional development always matches their intellectual development. Teaching safe practices when using the Internet, modeling proper use of technology resources, and monitoring children are some ways that parents and teachers can help avoid such problems (Siegle, 2010).

Second, descriptive articles on the use of technology to enhance curriculum for gifted learners have suggested the need to explore the numerous ways that the Internet and Web 2.0 tools can uniquely benefit gifted students. Readers are referred to Siegle (2007) to understand how various interesting activities, such as creating commercials, podcasts, and blogs, can encourage students to express their views and exhibit their understanding of content. Current research on using technology for 21st century skills (Dove & Zitkovich, 2003; Duda et al., 2010; Liu, 2004) has shown positive results for improving critical-thinking skills and differentiating curriculum for gifted students. More research on collaboration and communication opportunities over the Internet

is required. Gifted students, like all students, should be guided to selectively and efficiently use the Internet to support their learning strengths and needs (Schneider, 2009). As information overload and biased information available on the Internet can be major obstacles to using the Internet for learning, Schneider suggested using search engines dedicated to children, using browsers' safe search filter features, and modeling how to search, select, and evaluate resources from the Internet. Additional research on challenges and opportunities when using the Web can advance more effective practices.

Third, more research on the use of electronic portfolios and computer adaptive tests (CATs) will provide a broader perspective on technology-based assessments. Alternate assessments, such as e-portfolios, can help with assessing students' ongoing progress. Examples include digital photographs of students' projects, audio files of students' conversations during group work, and scanned pictures of students' art to document their learning (Siegle, 2002). In addition, CATs that present students with different test items based on their performance can be useful for preventing gifted students from getting bored or frustrated with the assessments. CATs can also be helpful for tracking students' growth over time in different content areas and challenging them in areas of their interests (Clark, 2004).

Fourth, many descriptive and evaluative reports have extensively discussed programming and providing various learning environments using technology. Some important questions for future research are:

1. How can we foster leadership abilities in gifted students (Gonsoulin, Ward, & Figg, 2006)?
2. What are some venues on the Internet that can provide opportunities for telementoring (Siegle, 2003) and forming enrichment clusters (Eckstein, 2009a; Renzulli & Reis, 2005) to benefit gifted learners from different parts of the world?
3. How can special populations of gifted students, including gifted girls, gifted adolescents, twice-exceptional students, and rural gifted students, benefit from emerging technologies (Belcastro, 2005; Heilbronner, 2009; Sheffield, 2007; Weber & Cavanaugh, 2006)?
4. What technology skills do gifted learners need to become responsible global citizens? (Gibson, Rimmington, & Landwehr-Brown, 2008),
5. What unique challenges do gifted children face while socializing on the Internet? Are dedicated websites, such as the Gifted Kids Network (Eckstein, 2009b), which allow gifted students to not only socialize with each other and share their interests but also discuss issues or concerns related to perfectionism or peer relations, more beneficial than generic social networks such as Facebook and MySpace?

Finally, a bibliometric analysis by Martin et al. (2011) identified social Web technologies, including Web 2.0 technologies, games, and mobile devices, as the most important technologies for education and pointed

out that research in general education reflected use of these technologies. Another area in technology where gifted education needs to keep up with general education is teacher technology professional development. As Besnoy (2007) noted, although most teachers are interested in using technology, they are not ready to integrate technology because of lack of sufficient and continuous professional development in technology and lack of access to resources. To enable this, technology training for teachers of gifted students, as in other areas of professional development, should be long term and ongoing. Topics from research highlights in technology and teacher education (Maddux, 2009; Maddux et al., 2010) also included addressing learner differences and engaging students through various emerging technologies, such as games, virtual worlds, mobile technologies, and online social networking. Finally, researchers can design and evaluate frameworks to promote innovative thinking and differentiating instruction for gifted and talented students.

Implications for Practice

Most researchers and practitioners have strongly discouraged using technology merely for drill and practice (Dixon et al., 2005; Siegle, 2003), as they emphasize using technology for advancing 21st century skills, such as critical thinking, creativity, and problem solving. Most important for gifted students, the use of technology should be geared to meeting not only their learning needs, but also their social and emotional needs (Cross, 2004; Cross, 2005) to help gifted students feel a sense of belonging and connection.

Technology strongly influences the everyday life of today's students, and their learning experiences in school should reflect this to prepare them for their futures. Based on our review, we observed that the research on technology use for gifted students and their teachers is minimal. Evidently, there is a need for more empirical research on using various technology tools and assessing their effectiveness for teaching gifted children. With the increasing interest and awareness about integrating technology, more research in this area will build a strong and quality education for 21st century learners.

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** Articles included in the literature review.*

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