

Conference Paper

The Role of Technology in Gifted and Talented Education: A Review of Descriptive and Empirical Research

Hayat Ali and Amal Alrayes

Abstract

Nowadays, we cannot exclude the use of technology from the technology-driven generation as the deployment of Information Technology become a necessity factor toward a successful process; especially in education due to its vital role in enhancing the students' knowledge and skills development. One type of students that technology plays a major role in their development is gifted and talented students who have unique learning needs that are often overlooked in the traditional education setting.

This research aims to explore the progress of technology use in gifted and talented education through reviewing and highlighting the best practices and research in this area based on both descriptive and empirical research. The review will include different areas of gifted programming such as learning and development, assessment, curriculum and learning environments.

For this purpose, the online database is employed to extract the research done in the field between years 2010 to 2018. The contribution of this research resides in its exposure to the best practices of integrating technology in gifted and talented education through which teachers and practitioners can be encouraged to adopt them into their contexts. It also provides the researchers with intensive review of technology adoption for gifted and talented education with some suggestions for future research where they can focus their research on.

Keywords: Technology, gifted, talented, education, online

Corresponding Author:

Hayat Ali

Received: 10 July 2019

Accepted: 4 September 2019

Published: 12 September 2019

Publishing services provided by
Knowledge E

 Hayat Ali and Amal

Alrayes. This article is distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use and redistribution provided that the original author and source are credited.

Selection and Peer-review under the responsibility of the Foundation Programs – Shaping the Future of ELT Conference Committee.

1. Introduction

Gifted education began very early in the eighteenth century. The field of gifted education continued to evolve mainly in response to the changing needs, especially after the Soviet Union's launch of Sputnik in the late 1950s (Davis, Rimm, & Siegle, 2011). With the renaissance and evolution of technology, the whole world started to employ ICT in the teaching process. In Kingdom of Bahrain, it started in 1986 by forming a Special Education Committee in the Ministry of Education to deal with the issues related to the students with special needs (i.e. slow learners, physically handicapped, blind, deaf, mentally retarded and gifted students). Therefore, by that, time gifted and talented

 OPEN ACCESS

students considered as a special education requirement for the ministry. Then during the period from 2000 to 2004, more efforts giving attention to the gifted and talented learners with several projects were implemented in the Center for the Care of Talented Student.

Gifted and talented students defined by the Federal of Unites States, as “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).

In this modern era, technology is considered as an educational and creative channel for some of the best students as well as it allows teachers to provide distinguished teaching methods for those talented students. 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 explore the progress of technology use in gifted and talented education through reviewing and highlighting the best practices and research in this area. This review will contribute to the literature by putting into perspective the best practices of integrating technology in gifted and talented education through which teachers and practitioners can be encouraged to adopt them into their contexts.

The National Association for Gifted Children [NAGC] has endorsed several strands: 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).

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

1. What are some key findings of research on technology used in gifted and talented education?
2. What areas can future research studies in gifted education address to keep up with the technological advancements?

2. Methodology

To review the existing literature and research in the field of technology for gifted and talented education, we searched online databases, including ERIC, Education Research Complete and Academic Research Complete using a Boolean combination of the following keywords: technology, gifted, and talented.

We organized the literature using Pre-K–Grade 12 Gifted Education Programming Standards (NAGC, 2010) that consists of 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 both descriptive and empirical researches that were published during the 2013–2018 time to include in this review.

After reading the abstract descriptions of the articles, we shortlisted 15 research articles out of 300 articles based on: a) their relevance to the six strands specified in the gifted education programming standards, and b) their focus on the use of technology with gifted students and their teachers.

The journals we extracted the papers from are in the following areas:

- a) Giftedness journals such as Gifted Child Quarterly (n = 4), Gifted Child Quarterly (n=3), Turkish Journal of Giftedness and Education (n=1), RoeperReview (n=1),
- b) Education and Learning journals such as International Journal of Learning (n=1), Teaching and Educational Research(n=1), and Journal of Advanced Academics (n=1),
- c) IT with other disciplines journals such as Journal of Information Technology Education or IT (n=1), Behavior and Information Technology (n=1),
- d) IT journals such as International Journal of Computer and Communication Engineering (n=1), and Procedia Computer Science (n=1).

Ten of the studies are descriptive and five studies are empirical studies. Table 1 presents a summary of relevant research studies. Out of the 14 articles, only four are empirical and the rest are descriptive researches.

3. Review of Literature

The literature organized using Pre-K–Grade 12 Gifted Education Programming Standards (NAGC, 2010) that consists of six strands of the programming standards include learning and development, assessment, curriculum and instruction, learning environments, programming, and professional development.

3.1. Curriculum and Instruction with Technology

Chen, Dai, & Zhou (2013) developed 'The enable, enhance, and transform framework' which can help to assess what has been done and what can be done with technology in gifted education in different areas including the designing and planning activities. They emphasized that technologies have been used as a curriculum delivery vehicle, a tool for administering and managing online gifted education programs, and a platform for building online learning communities. Also, A variety of ways to use technology in curriculum enrichment are found in the literature in different types of designing and planning learning activities general exploratory activities, group training activities, individual and small-group investigations of real problems.

In addition, Zimlich (2017) mentioned that technology could be both "a tool to provide a behavior trap and also a behavior trap in and of itself". He stressed that gifted students benefit when curriculum provides practice with complex topics, critical thinking, self-reflection, creativity, and access to mentors, which can be easily enabled by the use of technology. Thus, technology can help teachers meet the standards for gifted education programs if they choose to implement technology in meaningful ways that meet the needs of gifted students.

3.2. Programming with Technology Tools

NAGC (2010) stressed that gifted students should be given the opportunity to learn with different programming options, and individualized learning opportunities through independent study, mentorships, internships, and online courses.

Swan, Coulombe-Quach, and Huang (2015) conducted study to investigate a virtual learning lab (VLL) in a rural school district to meet gifted students. They found that VLL programming, specifically online instruction, could be an effective means for providing accelerated coursework to gifted students in middle school, which include cost-effectiveness, parent and student satisfaction, allowing for individualized work pace in talent area, and others.

Chen, Dai, & Zhou (2013) mentioned that there is a significant increase in the capacity of gifted programming with the technology. Thus, they empathized that without technology,

educational institutions cannot manage huge amount of students and instructors' data, organize the learning materials, and conduct efficient administrative work to those nationwide or even worldwide programs with limited resources

3.3. Technology and assessment

Gifted students can be assessed using different types of assessment such as assessments to identify gifts and talents, ongoing assessments of student learning, and assessments that evaluate a gifted program toward meeting the gifted students' needs (NAGC, 2010).

Chen, Dai, & Zhou (2013) stressed on the significant role of the technology on enabling the individualized and formative based which provides better student agency in the assessment as well as better guidance for next step teaching and learning for gifted program. They presented

Computerized adaptive testing (CAT) as an example, which provides testing items with difficulty levels responsive to the levels of knowledge and capabilities that the learner demonstrates (Olson, 2005).

3.4. Technology for Learning and Development

Siegle (2013) presented the use of technology for flipping the classrooms. He presented some advantage for gifted students such as enabling the teachers to provide gifted and talented students with advanced content beyond their grade level. In addition, they can create an option for gifted students to work on projects of common interest or to interact with each other and their teacher at higher levels (Pring, 2012). On the other hand, they presented many problems and criticisms of the Flipped Classroom such as having no access to technology, lack of gifted students' motivation to complete the homework, and the non-suitability of video lecture for learning.

Ucar, et al. (2017) conducted a research to identify the effects of force feedback haptic applications developed in virtual reality environments (VREs), which is an important field of study in computer science and engineering, on gifted students' attitudes towards chemistry education in learning process. The results reveals that there is a positive relation between using force feedback haptic applications which are developed in VREs and gifted students' attitudes towards educational programs more than the traditional education methods.

3.5. Technology in Learning Environments

Gifted students should be educated in an environment that encourages independence, motivation, and self-efficacy (NAGC, 2010). Potts (2018) did a case research to

understand profoundly gifted students' perceptions of virtual programs. The participants were 5 gifted students who were enrolled in a virtual writing course prepared by a school for gifted population. The data collected through asynchronous focus groups on an online discussion board, observations of synchronous sessions in their virtual classroom, and individual interviews with the participants. The participants expressed a preference for frequent interactions with classmates and the instructor, but they lacked the social interaction.

In addition, Ozcana and Bicen (2016) conducted a study to determine the gifted students' opinions on the use of technological tools including the technology usage in education. The results show that gifted students have given opinions about the educational use of technology mostly in the items that "I think that technological devices contribute to my education, "I find most of my homework from the Internet", and "Instead of asking my teacher about a problem during the lesson, I prefer asking him or her from the Internet".

Furthermore, Stoeger, Hopp, and Ziegler (2017) compared the effectiveness of one-on-one versus group online mentoring in STEM and they examined the conditions under which online group mentoring is particularly effective. The results show that group mentoring turned out to be more successful on all examined measures including the level of participation using online tools such as e-mail, and number of networks. In addition, the girls in the group-mentoring condition showed a significant increase in their elective intentions in STEM after 6 months.

Furthermore, Chen, Dai, & Zhou (2013) stressed that with IT communicating, interacting, and cooperating with distant peers is no longer a problem IT provides the gifted students with a new way to each people and break the social isolation as mentioned by Pyryt (2009).

In addition, in the area of employing the virtual reality environment in learning process, Ucar et al. (2017) identified the effects of force feedback haptic applications developed in virtual reality environments (VREs), in computer science and engineering, on gifted students' attitudes towards chemistry education in learning process. The results revealed that gifted students in the survey group have more positive thoughts than the control group about haptic application which indicates that it is more preferable than the traditional methods as it can increase the productivity in education.

In terms of readiness of gifted child for online learning, Potts and Potts (2017) published a journal article through which they raised 10 questions that include the acquisition of the basic computer and Internet navigation skills, the availability of time, the patience, flexibility, and adaptability of the child, the ability to deal with unforeseeable frustrations,

the acquisition of the reading comprehension and patience necessary to carefully follow written instructions, the ability to communicate frequently and effectively with both the instructor and classmates, the ability to create and manage a scheduling system for keeping track of deadlines, the ability to work independently, the extent of distractibility of the child, the extent of readiness to engage maturely with others in an online environment and the extent of interest in online learning. They empathized that both students and parents need to think reflectively about the answers to each of these questions as online learning is an amazing resource for gifted students, but the fit must be appropriate.

As the technology offers gifted children opportunities to explore advanced content and express their creativity, Siegle (2017) presented in their article 'the dark side of Using Technology', many negative consequences of technology such as plagiarism, cyberbullying, viewing inappropriate content, and technology addiction that require the attention of both parents and educators to guide gifted children to avoid them. For the cyberbullying, MacFarlane and Mina (2018) examined the cyberbullying and relevant concerns to educating high-ability students in terms of motivation for cyberbullying, resources, and considerations for working with young people in developing their social-emotional awareness. They stressed that parents, teachers, and counselors should work collaboratively to discuss with the children the forms of bullying, examples of bullies, and steps they can take to reduce the risks.

3.6. Technology and professional development

It is not only enough to use the appropriate technology in the appropriate learning context and make the gifted students' ready for the technology deployment to assure effective learning. However, how well the teacher is professionally development toward the technology deployment and use is an important concern specially that NAGC (2010) stressed on the effective use of technology by teachers for gifted students.

Findings from a research conducted by Zimlich (2015) using a qualitative study of six Alabama teachers of the gifted students indicate that educational technology use with students is shaped by factors including teacher attitudes and expertise, available equipment and support, pedagogical decisions related to working with technology, and the particular student group participating in the technology use.

TABLE 1: Summary of Research Articles Reviewed.

Author (year)	Education Programming Standards	Focus	Type of Research Descriptive/ Empirical	Data collection instruments
Chen, Dai, & Zhou (2013)	-Designing and planning learning activities with Technology -Technology and assessment -Programming with Technology Tools -Technology in Varied Learning Environments	Systematic way to conceptualize, incorporate and utilize the current technology in gifted education, namely, using “enable, enhance, and transform”	Descriptive (Secondary data from literature)	
Siegle (2013)	Technology for Learning and Development	The rationale for using the strategy with gifted students, possible problems educators might encounter, and practical tips for beginning the process of flipping the classroom.	Descriptive (Secondary data from literature)	
Zimlich (2015)	Professional Development Using Technology	The experience of teachers on how they use and shape technology experiences with students, and promote student learning	Descriptive	A qualitative multi-case phenomenological study of six Alabama teachers of the gifted examined how they use and shape technology experiences with students
Swan, Coulombe-Quach, and Huang (2015)	Programming with Technology Tools	Virtual Learning Lab (VLL) in a rural school district	Empirical	Qualitative using case study as an appropriate evaluation tool
Ozcana, and Bicen (2016)	Technology in Varied Learning Environments	Gifted students’ opinions on the use of technological tools.	Descriptive (primary data/ Quantitative tools.	Questionnaire
Suh (2016)	Programming with Technology Tools	Gifted Education Database (GED): Information Management and Online Teacher Recommendation System	Descriptive (Quantitative / Primary data)	Observation with statistical analysis
Zimlich, (2017)	Curriculum and Instruction Planning with Technology	Technology to the Rescue: Appropriate Curriculum for Gifted Students	Descriptive (Secondary data from literature)	
Potts and Potts (2017)	Technology in Varied Learning Environments	Is Your Gifted Child Ready for Online Learning?	Descriptive (Secondary data from literature)	

Author (year)	Education Programming Standards	Focus	Type of Research Descriptive/ Empirical	Data collection instruments
Siegle(2017)	Technology in Varied Learning Environments	The Dark Side of Using Technology.	Descriptive (Secondary data from literature)	
Edinger (2017)	Professional Development Using Technology	Online Teacher Professional Development for Gifted Education: Examining the Impact of a New Pedagogical Model.	Empirical	Quantitative through questionnaire
Stoeger, Hopp, and Ziegler (2017).	Technology in Varied Learning Environments	Online Mentoring as an Extracurricular Measure to Encourage Talented Girls in STEM (Science, Technology, Engineering, and Mathematics): An Empirical Study of One-on-One Versus Group Mentoring.	Empirical	Experiment with Statistical analysis
Ucar, Ustunel, Civelek and Umut (2017)	Technology for Learning and Development	Effects of using a force feedback haptic augmented simulation on the attitudes of the gifted students towards studying chemical bonds in virtual reality environment.	Empirical (Quantitative)	Experiment with Statistical analysis
Potts (2018)	Technology in Varied Learning Environments	Gifted Students' Perceptions of Virtual Classrooms	Descriptive (Primary data)	Focus groups on an online discussion board, observations of synchronous sessions in their virtual classroom, and individual interviews with the participants
MacFarlane and Mina(2018)	Technology in Varied Learning Environments	Cyberbullying and the Gifted Considerations for Social and Emotional Development	Descriptive (Secondary data from literature)	

4. Direction for Future Works

Reviewing the papers in technology in gifted/talented education, we still found more of many descriptive researches in comparison to the descriptive researches, which

was the observation of Periathiruvadi and Rinn (2010). Therefore, still more of empirical researches are needed. Furthermore, more deployment of qualitative research method and tools are required for the empirical research for both students and instructor perspectives for the different educational levels Zimlich (2015).

Although this is a passion for technology use in the field of gifted education. However, few researches examined specific technologies. Chen, Dai, & Zhou (2013) stressed that more innovative practices of using technology in gifted education are needed and they presented some remaining unanswered questions as follows:

- What kinds of technologies are more beneficial to gifted learners than others, and why?
- What are some important differences between using technologies and conventional instructional methods?
- How should current gifted education be prepared for the technology-enhanced education transformation in the future?

In the area of blended learning for gifted students, Swan, Coulombe-Quach, and Huang (2015) suggested follow-up research to increase the understanding as to how the Virtual Learning Lab (VLL) experience will affect these gifted students in high school and beyond. We also found few researches that investigate the role of technology for gifted students in the higher education, which also raise the need for a standard for gifted students in higher education.

In the area of technology support of the gifted programs, Chen, Dai, & Zhou (2013) mentioned that there is little research on how exactly the technologies have been adopted to improve the efficiency of managing the gifted education programs or how to improve the functionalities of technology toward better meeting gifted programs' needs. Furthermore and according to the reviewed papers, it was found that very few researches investigated the use of IT for assessing the gifted students specially the type of assessment that assess ongoing assessments of student learning (NAGC, 2010). that is called "assessing for learning" or "formative assessment".

In terms of the data collection instruments for the empirical study, more of qualitative tools are to provide more in depth conclusion about the role of IT in gifted and talented education.

5. Implications for Practices

As the technology have a bright side in improving the learning for gifted students, it has many negative consequences such as plagiarism, cyberbullying, viewing inappropriate content, and technology addiction as mentioned by Siegle (2017). Therefore, before these consequences happen, both parent and teachers' collaboratively have to take some pre-caution actions to help the gifted students facing them.

Furthermore, before the employment of the Technology in teaching and learning process, the teachers need to prepare the students to work on the online environment using the different technology tools to assure the success of technology empowerment in teaching gifted students and fulfilling their needs and skills. In this area, some of the readiness questions raised by Potts and Potts (2017) can be considered. In addition to the students' readiness, the teachers have to be well prepared to use the technology effectively in the learning process as their attitude and technology expertise is a vital factor toward shaping the educational technology use with students (Zimlich, 2015).

6. Limitations of Research

Before making a generative conclusion about research in using technology tools with gifted students, some limitations need to be considered. First, we used the six strands of six programming for gifted education that may limit the classifications of the paper. In addition, it is worth considering that we use our own judgment for the classifications where other authors could have other classifications as one paper could be fitted in many strands. Furthermore, the papers were only extracted from ERIC, Education Research Complete and Academic Research Complete where other papers in other online databases could be also considered.

References

- [1] Chen, J., Dai, D., & Zhou, Y. (2013) Enable, Enhance, and Transform: How Technology Use Can Improve Gifted Education. *Roeper Review*, 35(3),pp. 166-176,DOI: 10.1080/02783193.2013.794892.
- [2] Davis, G. A., Rimm, S. B., & Siegle, D. (2011). *Education of the gifted and talented* (6th ed.). Boston: Pearson.
- [3] Edinger, M. (2017) Online Teacher Professional Development for Gifted Education: Examining the Impact of a New Pedagogical Model. *Gifted Child Quarterly*

61 (4), pp.300-312

- [4] MacFarlane, B., and Mina, K. (2018). Cyberbullying and the Gifted Considerations for Social and Emotional Development. *Gifted Child Today*, 41(3), pp. 130-135.
- [5] National Association for Gifted Children. (NAGC). (2010). Pre-K–Grade 12 gifted programming standards. Retrieved from <http://www.nagc.org/index.aspx?id=546>
- [6] Olson, A. (2005). Improving schools one student at a time. *Educational Leadership*, 62(5), 37–40.
- [7] Ozcana, D., and Bicen, H. (2016) Giftedness and technology. *Procedia Computer Science*, 102 (2016), pp. 630 – 634.
- [8] Periathiruvadi, S. and Rinn, A. (2012) Technology in Gifted Education: A Review of Best Practices and Empirical Research. *JRTE*, 45 (2), pp. 153–169
- [9] Potts, J. (2018). Profoundly Gifted Students' Perceptions of Virtual Classrooms. *Gift Child Quarterly*, 63(1) Potts, J., and Potts, S. (2017) Is Your Gifted Child Ready for Online Learning? *Gifted Child Today*, 40(4), pp. 226-231.
- [10] Pring, L. (2012). The benefits of a flipped classroom for gifted students. Retrieved from: http://prezi.com/bgiz-evgv5_s/the-benefits-of-a-flippedclassroom-for-gifted-students/.
- [11] Pyryt, M. C. (2009). Recent developments in technology: Implications for gifted education. In L. V. Shavinina (Ed.), *International handbook on giftedness* (pp. 1173–1180). New York, NY: Springer
- [12] Sheffield, C. C. (2007). Technology and the gifted adolescent: Higher-order thinking, 21st century literacy, and the digital native. *Meridian*, 10, 5. Retrieved from <http://www.ncsu.edu/meridian/sum2007/gifted/index.htm>
- [13] Siegle, D. (2017) The Dark Side of Using Technology. *Gifted Child Today*, 40 (4), pp. 232–235.
- [14] Siegle, D. (2013) Technology: Differentiating Instruction by Flipping the Classroom. *Gifted Child Today*, 37(1), pp.51-55.
- [15] Stoeger, H., Hopp, M., and Ziegler, A. (2017). Online Mentoring as an Extracurricular Measure to Encourage Talented Girls in STEM (Science, Technology, Engineering, and Mathematics): An Empirical Study of One-on-One Versus Group Mentoring. *Gifted Child Quarterly* 61(3), pp. 239–249.
- [16] Suh, Y. (2016) Gifted Education Database (GED): Information Management and Online Teacher Recommendation System. *Turkish Journal of Giftedness and Education* 2016, 6(1), pp.44-53.

- [17] Swan, B., Coulombe-Quach, X., and Huang, A. (2015) Meeting the Needs of Gifted and Talented Students: Case Study of a Virtual Learning Lab in a Rural Middle School. *Journal of Advanced Academics*, 26(4), pp. 294–319
- [18] Ucar, E., Ustunel, H., Civelek, T., and Umut, I. (2017) Effects of using a force feedback haptic augmented simulation on the attitudes of the gifted students towards studying chemical bonds in virtual reality environment. *Behavior and Information Technology*, 36 (5), pp. 540–547.
- [19] Zimlich, S. L. (2015). Using technology in gifted and talented education classrooms: The teachers' perspective. *Journal of Information Technology Education: Innovations in Practice*, 14, 101-124. Retrieved from: <http://www.jite.org/documents/Vol14/JITEv14IIPp101-124Zimlich0846.pdf>.
- [20] Zimlich, S. (2017) Technology to the Rescue: Appropriate Curriculum for Gifted Students. *International Journal of Learning, Teaching and Educational Research*. 16(9), pp. 1-12