



Technology Use in Gifted and Talent Education in Saudi Arabia: Students' View of its Use and its Impact on their Learning Potential

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Abstract: Innovations in learning technologies can contribute to more interactive teaching and learning environments and activities that support richer autonomous and collaborative student learning. The aim of this literature review study was two-fold. First, to gauge Saudi gifted and talented students' views of the integration of technologies for learning into enrichment programs and differentiated curriculum approaches. Second, to investigate how technologies for learning in enrichment programs and differentiated curriculum approaches contribute to Saudi gifted and talented students' learning and development. This study undertook a review of current research and industry literature related to technology use in gifted and talented education in Saudi Arabia. Analysis was conducted related to research findings on students' learning and development, curriculum planning and implementation, students' learning environments, and programming. The findings revealed Saudi gifted and talented students generally perceived the use of technologies made a positive contribution to the development of their creativity skills and their innovative thinking. They also indicated however that their technology-based online learning experience was at times inefficient and ineffective at supporting their learning outcomes. This literature review study also technology use in gifted and talented learning settings in Saudi Arabia contributed positively to the development of students' learning. It was concluded that Saudi teachers of gifted and talented students must continue to develop their capabilities and have access to support to utilise learning technologies in meaningful ways to meet the expectations of gifted education programs.

Keywords: Technology, gifted, talented, education, teachers



Introduction

Innovations in learning technologies are broadly considered to have contributed to more interactive teaching and learning environments and activities that support richer autonomous and collaborative student learning. Such technological innovations are increasingly embedded into gifted and talented student education. Technologies in this context may include access to technology labs, the use of computers or tablets in the classroom; incorporating digital camera, video camera, and/or smartphone use into the learning activities; and the use of robotics, virtual reality software, interactive whiteboards, and projectors by the teacher. Technologies for learning are considered by experts to provide teachers of gifted and talented students with more sophisticated and effective instructional tools (Ali & Alrayes, 2019). Moreover, they can also provide gifted and talented students with more opportunities for individuality, creativity, and interactivity in learning as well as the development of higher-order thinking skills (Ali & Alrayes, 2019; Kontostavlou & Drigas, 2019; Zimlich, 2015).

In this way, the use of technology in gifted and talented learning environments can provide the students with the tools to give expression to or to perform their giftedness or talents through the processes of self-directed learning or to explore their own interests (Ozcan & Bicen, 2016). It is therefore not surprising that increased interest in technology-based learning has emerged as a pathway of improving the abilities of teachers to deliver broader services and more engaging learning materials to gifted and talented students (Almuttairi, 2020; Picciano & Seaman, 2009). Moreover, such technologies are increasingly viewed as beneficial to meeting the learning needs of gifted and talented students as well as to engaging them in the learning process (Zimlich, 2017). This is true of the gifted and talented education context in Saudi Arabia.

Gifted and talented education in Saudi Arabia including the differentiated education of students has been an increasingly important focus area for the Ministry of Education (MoE) in Saudi Arabia in recent decades (Battal, 2016; Mohammed, 2018). In turn, the National Transformation Program 2020 was established by the Saudi government as the first phase of the Vision 2030 initiative (Bojulaia & Pleasants, 2021). Through the General Directorate of Gifted Care, the Saudi MoE endorses four main forms of educational provision for gifted and talented students: special schools, special classes for gifted students in selected schools, pull-out enrichment programs, and academic acceleration (Alamiri, 2020). Furthermore, to help realise the goals of the Saudi Government's Vision 2030, the MoE supports implementation of the Special Classes for Gifted Students initiative in some mainstream schools (Alamiri, 2020).

The Saudi Ministry of Education (MoE) has subsequently focused its attention on developing the creativity and critical thinking skills of gifted and talented students. This is to be delivered through out-of-school centres to provide addition and differentiated educational and instructional programs to students along special classes for gifted students within schools. Both of these are under the direction of the Public Administration for Gifted Students (Bojulaia & Pleasants, 2021). This is in addition to the work of the King Abdulaziz and His Companions Foundation for Giftedness and Creativity, or Mawhiba. A stated aim of Mawhiba is to work in partnership with the Saudi MoE to "cultivate a comprehensive environment of creativity" (p. 183) through the provision of gifted classes and enrichment programs and competitions for gifted and talented students (Bojulaia & Pleasants, 2021).



While responding to the need for further investment in proper infrastructures in schools, as part of the Vision 2030 initiative, the Saudi Government and MoE are simultaneously seeking an e-learning digital transformation (Ministry of Education, 2017). As a result, a range of projects to support the development of technology-based education have been developed and implemented including the National E-learning and Distance Learning Centre (NEDLC), the introduction of information communication technology (ITC) into school curricula, the King Abdullah Project for Computers, and the provision of training to Saudi teachers to improve their skills in technology use in the classroom (Alamrei et al. 2021). In addition, the NEDLC recently launched several e-learning initiatives with the focus on developing the digital skills of both students and teachers. They include (a) the Virtual School Initiative, (b) the Unified E-learning and Training Platform initiative, (c) the Digital Content Portal Initiative, and the (d) Governance and Operation Initiative (Ministry of Education, 2017).

The Digital Content Portal for instance is an initiative from the MoE to provide interactive books and supporting media to facilitate the implementation of learning programs (Alamrei et al., 2021). The portal supports the provision of multimedia technologies to promote student learning and more active interaction and engagement in the learning experience (Ali & Alrayes, 2019). This and the other e-learning initiatives are relevant to the provision of gifted and talented education in Saudi Arabia as they provide these students with more opportunities to access multiple education sources and platforms to meet their individual learning needs and styles and promote self-motivation for learning (Alamrei et al., 2021). Furthermore, they provide gifted and talented students particularly with opportunities for advanced learning through the self-directed exploration of learning content, the formulation of knowledge through problem solving, and creative expression (Alamrei et al., 2021).

Research Problem

It is broadly accepted that gifted and talented students possess metacognitive thinking abilities and approaches to learning and creative expression that require more tailored teaching and learning activities from the teacher (Al-Hamdan et al., 2017; Almuttairi, 2020; Yoon, et al., 2020). Metacognitive thinking in this context refers to the gifted and talented students' ability to "think, plan, monitor his/her performance, and evaluate his/her own learning" (Almuttairi, 2020, p. 30). The integration of new technologies in enrichment learning programs for gifted and talented students will enhance their skills in general and metacognition in particular (Almuttairi, 2020). Improving gifted and talented students' metacognition is an important outcome because it improves the gifted and talented students' capacity of assimilation of learning content at different stages of learning and provides them with a platform to adopt full responsibility for and control over of their learning skills (Ibrahim, 2014).

In response, the Saudi MoE has indicated its commitment to introducing technologies for learning in the field of education – including for gifted and talented education as part of its vision to promote quality educational outcomes through the development of students' skills and creativity (Hugail, 2016; Ministry of Education, 2017). Indeed, Alamrei et al. (2021) notes that the Saudi MoE is committed to keeping pace with the advances being made in developed countries in regard to the integration of technologies for learning across all levels of education. Notwithstanding this stated commitment, a review of the broader literature suggests there is still work to be done by the Saudi MoE to ensure schools are equipped with the necessary infrastructures and learning programs to take full advantage of the technologies available for educational practices in modern



schools (Alamrei et al. 2021). Moreover, some authors (e.g., Alelyani, 2020) have noted that research studies on special education provision in Saudi Arabia often conclude that gifted and talented students often “possess underdeveloped skills in problem solving, analysis and critical thinking” (p. 125).

Gifted and talented students can be supported to maximise their learning potential and skills development through tailored and purposefully designed learning activities and experiences (Alamrei, Keefe, & Alterator, 2021). This support is often provided through the development of enrichment programs and the implementation of a differentiated curriculum. Such enrichment programs aim simply to “put the learner at the heart of the education system” (p. 3) through the development and implementation of more personalised learning activities tailored to the specific needs the student (Leadbeater, 2004). In turn, such programs for gifted and talented students are often implemented within the framework of a differentiated curriculum which supposes that each student has both a unique learning style and abilities, along with varying interests and strengths (Tomlinson, 2014).

The Saudi Government and MoE more specifically understand the important role that technology has in a modern education system (Ministry of Education, 2017). However, “personalised learning and the differentiated curriculum are new concepts for education in Saudi Arabia” (p. 128). As a result, the Saudi MoE is still developing programs and systems to work with schools to develop and implement curricula which align with modern scientific and technological developments (Alamrei et al., 2021). In addition, the concerns and issues raised in the literature in recent years places a question mark over the effectiveness of the developments in the use of technologies for learning in Saudi Arabia’s gifted and talented education program (Alamrei et al., 2021). In particular, the extent to which technology use is playing an increasingly positive active role in education service delivery and delivering more effective teaching practices and better learning outcomes for gifted and talented students (Aldossari, 2018).

Research Importance

Gifted and talented education provision aims fundamentally to identify and implement the most effective approaches to supporting students to achieve to the potential (Tomlinson, 2014). Technology can be integrated into gifted and talented enrichment programs and differentiated curriculum activities to achieve multiple objectives including to direct and organise student learning, differentiate learning activities, and promote both autonomous and collaborative learning (Yang, Chang, Cheng, & Chan, 2016; Zimlich, 2017). Indeed, the use of technology in gifted and talented classrooms can provide “complexity in differentiated or individualized learning” (Zimlich, 2017, p. 1). That is, technology-based learning tasks can build the metacognition and critical thinking skill of the students through problem solving, collaborative or shared work, and simulations (Zimlich, 2017).

Research has shown that Saudi teachers of gifted and talented students perceive technology to provide a useful tool for differentiated instruction (e.g., Alshareef, Imbeau, & Albiladi, 2022).

Research Aims / Questions

Given the current understanding of the benefits of technology-based learning to support gifted and talented students to achieve to their learning potential, along with the increasing importance of gifted and talented education service provision in Saudi Arabia, this literature study aimed to answer the research question:



1. What are Saudi gifted and talented students' views of the integration of technologies for learning into enrichment programs and differentiated curriculum approaches?
2. In what ways are technologies for learning in enrichment programs and differentiated curriculum approaches for gifted and talented students in Saudi Arabia contributing to the students' learning and development?

Research Methodology

A search of online databases (e.g., ERIC, Google Scholar, Academic Research Complete, Academic Search Premier and Education Research Complete) was conducted to review current research and industry literature related to technology use in gifted and talented education. Boolean combinations of keywords were applied including technology / technologies for learning, gifted, talented, enrichment, differentiated curriculum. To organise the available literature the National Association for Gifted Children (NAGC, 2010) Pre-K–Grade 12 Gifted Education Programming Standards were used. The programming standards comprise: (1) learning and development, (2) assessment, (3) curriculum planning, (4) learning environments, (5) programming, and (6) professional development. This study included peer-reviewed articles only of descriptive or empirical research published between 2012 and 2022. The Abstract of each article was read initially to determine its eligibility for inclusion. From the more than 70 articles initially retrieved, five were shortlisted for inclusion in this literature review study. This low number of articles points to the scarcity of studies in the Saudi Arabia context to focus directly on technology use in gifted and talented education settings (i.e., enrichment programs, differentiated learning environments) as well as to be relevant to the six domains of the NAGC education programming standards.

Research Studies of Technology for Gifted and Talented Education in Saudi Arabia Saudi Students' General Views of Gifted and Talented Learning Settings

Programs for gifted and talented students including acceleration, pull-out programs, differentiated curriculum, and enrichment programs all support the fundamental recognition that these students can transform their giftedness into talents in particular domains (Ayoub, Alabbasi, Runco, & Acar, 2020). Focusing on gifted and talented education provision in Saudi Arabia, Aichouni et al. (2015) conducted a study of 66 gifted students for their perceptions of their learning environments. The gifted students were selected from the cohort who participated in the National Competition on Giftedness in 2015 held by the Saudi MoE. Indeed, the study was conducted as part of a Saudi MoE funded national research project which aimed "to enhance and to develop creativity and innovation" (p. 1371) among Saudi school and university students (Aichouni et al., 2015). Using a quantitative survey (including 5-point Likert-scale response options) for data collection, the participants were asked to provide comments on their personal views of creativity and innovation, the educational settings, and programs they experienced, and the types and nature of the support and management they received. The authors reported that the students perceived the educational setting including their teachers, the curriculum, and use of technologies in the classroom contributed positively to the development of their creativity skills and capacity for innovative thinking (Aichouni et al., 2015).

This finding reflects the findings in previous research in the international context. The research evidence here shows that gifted and talented learners hold positive attitudes towards the integration of technology into their classrooms (Periathiruvadi & Rinn, 2012). For instance, Ozcan and Bicen (2016) conducted a study of 105 gifted and talented



secondary school students enrolled at a Science and Art Centre in **Cyprus** for their opinions on technology use in education as well as technology use (social media platforms) as a communication tool. The authors found the gifted and talented students believed technology played an important role in their education and was a vital part of their communication with others. Regarding technology use for education specifically, the gifted and talented students indicated that technology use contributed to their education by providing new platforms and pathways to completing their learning tasks and homework (Ozcan & Bicen, 2016). Moreover, research shows that gifted and talented students, and their teachers generally acknowledge the benefits that technologies for learning can provide for multiple aspects of learning including program implementation, evaluation of learning processes and outcomes, curriculum development, and for enhancing the learning environment (Almuttairi, 2020; Periathiruvadi & Rinn, 2012).

Technology and Online Learning in Saudi Arabia

Research evidence about the uses and impacts of online learning platforms for gifted and talented students is also starting to emerge from studies conducted during the height of the global COVID-19 pandemic. Aboud (2021) for example examined the views of 30 gifted students and their parents (n = 15) regarding online learning provision in Saudi Arabia during the COVID-19 pandemic. This context is particularly relevant to an investigation of the role of technologies for learning in gifted and talented education contexts given the transition to online learning formats during the pandemic by most education sectors around the world (Weeden & Cornwell, 2020). The type of technologies utilised for online learning across Saudi Arabia during the pandemic are described in the study as “state-of-the-art devices through an educational computerization project” (Aboud, 2021, p. 11).

The project being referred to is part of the broader national computerisation initiative to introduce into Saudi educational institutions new technological devices and high-speed broadband communication to improve delivery of technology-based learning systems. In turn, this initiative is relevant to gifted and talented education programs in Saudi Arabia because the technology-based learning materials and learning opportunities are considered by some to be particularly advantageous for gifted and talented students' learning style preferences and needs (Lesia & Nettelton, 2015; Pfeiffer, 2018). Aboud (2021) used qualitative data collection methods including semi-structured interviews, interviewer observations, and interviewer note-taking. Focusing on the findings relevant to the gifted and talented students, the author found they generally held negative perspective of online learning. Most students indicated being enthusiastic to participate in online learning due to the perceived affordances the technologies provided them to create their own knowledge and conduct self-directed learning. However, most students also reported that the technology-based online learning experience was inefficient and ineffective at supporting autonomous and connected learning (Aboud, 2021).

These findings contrast to those reported in previous studies. For instance, Karpova, Shtefan, Kovalska, Ionova, and Luparenko (2020) conducted a study of how 73 gifted students in Kharkiv, Ukraine for their views on the introduction and integration of technologies for distance learning and their impact on the students' informational-digital competence. The authors reported that the students' indicated positive views towards the use of new ICT tools for learning and that the technologies had a positive impact on the development of and informational culture and the informational-digital competencies of the students.



Technology and Enrichment Programs in Saudi Arabia

The term enrichment in the context of gifted and talented education denotes the design of learning programs to expand upon and deepen the learning experiences and activities provided through the regular curriculum (Renzulli, Reis & Brigandi, 2020). Such enrichment opportunities can be implemented in gifted and talented classrooms using a variety of approaches and management methods (Renzulli et al., 2020). In turn, the development of enrichment programs for gifted and talented students that incorporate learning technologies are increasingly considered to provide flexibility of structure and content to meet the unique and diverse learning needs and interests of the students (Aljughaiman & Ayoub, 2012). Moreover, the technological tools can eliminate the need students to be subjected to learning at the same pace or to provide more advanced learning challenges to use their learning time more efficiently (Aljughaiman & Ayoub, 2012).

Al-Zoubi and Rahman (2015) conducted a study of 142 gifted and talented students enrolled at the Najran Centers for Gifted in Saudi Arabia to determine their level of satisfaction with the performance of the centres. The aims of the Najran Centers for Gifted are to identify the gifted and talented students and to provide purposefully designed opportunities for them to develop their giftedness, talents, and creativity. This is achieved by offering the students enrichment programs in different subject areas (e.g., Science, Literature, Arts) and by developing their thinking strategies, abilities to problem solve, and research skills (Al-Shehri, Al-Zoubi, & Bani Abdel Rahman, 2011). There have been 50 Centers established by the MoE across Saudi Arabia (MoE, 2015). The authors indicated that the rationale for their study emerged from the view that gifted and talented education in Saudi Arabia and indeed Arab societies more broadly was an important contributor to “greater cultural and scientific progress” (p. 2) into the future (Al-Zoubi & Rahman, 2015).

Using a quantitative questionnaire for data collection, the study found the gifted and talented students were very satisfied with the teachers and the administration of the Najran Centers for Gifted in Saudi Arabia. However, the students indicated only moderate satisfaction with the design of the enrichment activities, some teaching practices, and the facilities and equipment, including the uses of technologies to facilitate teaching and learning (Al-Zoubi & Rahman, 2015). Based on their findings, the authors pointed to the need to further improve the educational policies for gifted and talented education in Saudi Arabia. In particular, the direction of the policies to establish learning institutions and enrichment programs and differentiated curriculum to meet the unique needs of gifted and talented students.

A similar finding was reported in the United Arab Emirates (UAE) context. For instance, recent study by Ismail, Alghawi and AlSuwaidi (2022) aimed to review the current provision of gifted and talented education in the UAE from “a learning resource perspective” (p. 1). The rationale for the study provided by the authors was in response to the increasing importance being given the gifted and talented education provision to identified students in the UAE (Ismail et al., 2022). Their study links to technology use in gifted and talented education provision via the establishment of online mentoring hubs in the UAE. These hubs aim to offer motivated gifted and talented youths the opportunity to develop their knowledge and skills in STEM (Science, Technology, Engineering, and Mathematics) with the support of ‘expert’ mentors in these subject fields (Stoeger, 2020).

To support their review of gifted and talented provision, the authors conducted interviews with key stakeholders (n = 21) including upper-middle-school gifted students (n = 6), teachers of gifted students (n = 9), parents of gifted students (n = 3), and



government policy administrators (n = 3). The authors also performed document analyses of relevant national policies and regulations including short- and long-term general and specialised plans, gifted and talented programs, specialised reports, and distributed news-circular. The finding reported by Ismail et al. (2022) were that the UAE had made significant progress in aspects of gifted and talented education service provision, drawing particular attention to values of 'student equity' and 'student excellence' apparent in the system. Regarding technology use specifically, the authors found that its use by gifted and talented student was developing, but with some students and teachers still struggling to optimise their affordances for teaching and learning in the classroom.

More recently, Alabdullatif (2020) conducted a study to examine the challenges associated with planning an enrichment program focusing on the self-regulated learning (SRL) of gifted students. The plan for the enrichment program comprised three stages: preparation, implementation, and development. Specifically, during the preparation stage the enrichment program including technologies for learning was designed, applied, and evaluated for improvement. The implementation stage included two experiments: a summer enrichment program conducted with 20 male, intermediate stage students (experimental group); and an experiment with 20 male and female eight grade students attending the Renzulli Academy in the United States (US) (control group). Pre- and post-test formats were used to determine changes in the gifted students' (experimental group) capacities for SRL. The development stage of their study included interviews with the presenters of the program to explore the efficacy of the program implementations. Alabdullatif (2020) reported statistically significant differences between both the experimental group's pre and post-test scores for SRL following their engagement in technology-based enrichment learning programs.

Also focusing on enrichment program provision in Saudi Arabia, Almuttairi (2020) conducted a study of 38 female gifted students attending secondary level in Jeddah. The aim of his study was three-fold: to assess the impact of using a mobile learning app (iTunes U) during an enrichment program to develop the students' metacognition skills; to assess the level of gifted and talented students' satisfaction with using the iTunes U mobile app; and to develop the students' metacognitive thinking skills. As Almuttairi (2020) explained, iTunes U is a mobile application, which offers teachers "a direct and dynamic way ... to design, implement and deliver complete courses supported by visual and audio tutorials" (p. 30). To measure the metacognitive performances of the students the researcher used a Satisfaction scale for assessing the technique used and the final product following completion of the enrichment program. As reported by Almuttairi (2020), the Saudi female gifted students demonstrated significant improvement in metacognition skills development and performance overall from using iTunes U. This is combined with a result showing 94% satisfaction level among the participants for using the iTunes U app for learning in general and for metacognition skills development more specifically.

The findings reported by Al-Zoubi and Rahman (2015), Alabdullatif (2020), and Almuttairi (2020) in their respective studies regarding the positive impacts of digital and other technology applications on the learning outcomes of Saudi gifted and talented students align with international research findings. In a recent study by Avcu and Er (2020) of the impact of design thinking applications for teaching programming to 25 gifted and talented students, the authors reported positive impacts on the students' abilities to learn and practise computational concepts and to the development of their design thinking skills. A study by del Carmen Trillo-Luque et al. (2020) of English as a foreign language gifted and talented student in Spain found that technology use including



mobile learning devices combined with gamification activities in online learning contributed to a faster pace of foreign language learning by the students. Lastly, a study conducted by Al-Zoubi (2014) to investigate the effect of enrichment programs on 30 7th Grade gifted and talented students' academic achievement also reported positive outcomes. The students were attending the Al-Kourah Pioneer Center for gifted and talented students in Jordan and the author reported that the research projects and science activities in the enrichment program contributed to the development of the students' academic achievements and cognitive and social skills.

Ayoub et al. (2020) also recently conducted a study to evaluate the summer enrichment program which encouraged the gifted students to engage in and develop skills related to problem finding (PF) and active open-minded thinking (AOT). The participant in their study were 60 female gifted students in Grade 8 of Grade 9 (mean age of 14.2 years) from schools located in the Eastern region of Saudi Arabia. These 60 participants attended a summer enrichment program on robotics in 2018. In their study, PF refers to the ability to identify discrepancies or contradictions, and to formulate new hypotheses about old issues or problems. AOT refers to the willingness of the students to consider alternative views and opinions and for reflective thought. According to Ayoub et al. (2020), robotics is a feature of many gifted programs because the students are provided with the opportunity to engage learning across multiple forms and fields including science and technology, engineering, problem solving, and teamwork. It is not surprising, therefore, that the design and implementation of enrichment programs for gifted and talented students over recent years have increasingly included robotics (e.g., Al-Hamdan et al., 2017; Yoon, et al., 2020).

The robotics-based enrichment program in Ayoub et al.'s (2020) study was designed around four parts: scientific (robotics) content, enrichment activities, scientific excursions, and competitions. These four components collectively required the gifted students to develop/design robots to resolve an ill-defined problem using flexible thinking and creative thinking skills (Ayoub et al., 2020). Using pre-test/post-test format of the Active Open-minded Thinking Scale and the Problem Generation Test for data collection, the authors found a significant difference between the pre- and post-test outcomes for overall AOT scores and for PF originality scores following the gifted students' participation in the robotics-based enrichment program (Ayoub et al., 2020). Ayoub et al. (2020) concluded from their results that technology-based learning in the form of a robotics enrichment program helped the Saudi female gifted students to develop their abilities to gather and evaluate facts and information. In addition, the program assisted the students to formulate ill-defined problems and to problem solve by considering different perspectives.

These findings regarding the benefits to Saudi gifted and talented students learning processes and outcomes from engaging with technologies for learning in enriched and differentiated learning settings align with findings from previous research. Jagust, Cvetkovic-Lay, Krzic and Sersic (2017) conducted a study of the use of robotics technology in enrichment programs for 15 primary school gifted and talented students in Zagreb, Croatia. The authors found the use of robotics technology in this setting contributed positively to the students' motivation and capacity for independent learning, problem solving skills, and creativity.

Discussion

Enrichment programs and differentiated curriculum for gifted and talented students include learning activities that extend upon the mainstream curriculum (Ayoub et al.



2020). They are recognised as a curriculum option for use to maximise the achievements and skills development of gifted students, providing them with a deeper knowledge of learning content, and enhancing their critical thinking and creative thinking skills (Davis et al., 2011; Kim, 2016). In this way, a critical analysis of enrichment programs and differentiated curriculum typically focus on two key elements: method of delivery including technology use, independent study, and summer programs; and teaching and learning process such as problem-based learning (Davis et al., 2011).

Saudi gifted and talented students' views about the use of technology for learning

This literature review study sought to answer two primary research questions. The first question was regarding what current research indicates about Saudi gifted and talented students' views about the integration of technologies for learning into enrichment programs and differentiated curriculum approaches (RQ1). The findings of the examination revealed that Saudi students has mixed views about current technology use for gifted and talented education. As reported by Aichouni et al. (2015), the students in their study generally perceived the use of technologies in the gifted and talented classroom made a positive contribution to the development of their creativity skills and their innovative thinking.

The research evidence also shows that gifted and talented students generally perceive digital learning technologies to have an important role in their education (Ozcan & Bicen, 2016). The results from the different studies reviewed above conducted in Saudi Arabia and internationally suggest that technology use in gifted and talented education programs can help to increase the motivation and abilities of students to generate new knowledge and approach learning from different perspectives Ayoub et al. (2020). This arguably reinforces the view that the integration of technologies for learning in enrichment program activities for gifted and talented students can help them to both organise their knowledge as well as develop their knowledge processing system (Dennis & Vander Wal, 2010). Moreover, as Ayoub et al. (2020) have claimed, enrichment programs with technology integration supports gifted and talented students to explore alternative ways of thinking and to demonstrate cognitive flexibility.

In contrast, however, this study's review of the research evidence also revealed that Saudi gifted and talented students also believed there was room for improvement in the uses of technology in gifted and talented education programs. As reported, Al-Zoubi & Rahman (2015) found Saudi gifted and talented students attending the Najran Centers for Gifted indicated only moderate satisfaction with the design of the enrichment program, teaching practices, and uses of technologies to facilitate teaching and learning. They also indicated the need to further improve educational policies for gifted and talented education in Saudi Arabia. Similarly, the research evidence shows Saudi gifted and talented students had mixed views about their experiences of using technologies for learning, specifically online learning, during the COVID-19 pandemic. While the students participated in Aboud's (2021) study for instance indicated being enthusiastic about participating in online learning and using technologies to facilitate the learning process, they also indicated that the technology-based online learning experience was at times inefficient and ineffective at supporting their learning outcomes (Aboud, 2021).

These mixed views of the benefits and efficiencies (or inefficiencies) of technology use in gifted and talented education in Saudi Arabia highlight the need for further progress in this field. As suggested in the broader literature, the technologies for learning must not only present as fundamental tools for academic interactions in classrooms but also as tools for enhancing gifted and talented students' learning potential (Vértiz-Osores, Pérez-



Saavedra, Faustino-Sánchez, Vértiz-Osores, & Alain, 2019). The differentiated curriculum approach and the use of enrichment programs in gifted and talented classrooms remain two areas considered to potentially benefit from such progress in learning technologies. However, the integration of technology in gifted and talented classrooms and enrichment programs in Saudi Arabia must do more to 'open up' the learning processes of students as well as the opportunities for teachers to facilitate more targeted and meaningful learning experiences Vértiz-Osores et al., 2019).

How technologies for learning in gifted and talented education programs in Saudi Arabia contributes to students' learning and development.

This literature review study also aimed to explore how technologies for learning in enrichment programs and differentiated curriculum approaches for gifted and talented students in Saudi Arabia contributed to students' learning and development (RQ2). A primary objective of a gifted and talented education program is to provide students with differentiated learning programs to properly meet their cognitive, emotional, and social needs (Renzulli, 2012). Moreover, it is broadly acknowledged that a key advantage of using learning technologies for teaching gifted and talented students is the opportunity they provide to the students to both develop and practise higher-order thinking skills (Alqahtani & Alqahtani, 2021). In turn, when using learning technologies in gifted and talented classrooms teachers must consider the characteristics of the gifted and talented students which may often include heightened curiosity, learning initiative, the pursuit of originality and creativity, and a dedication to higher achievement (Kontostavrou & Drigas, 2019).

The review of current research evidence from Saudi Arabia revealed technology use in these gifted and talented learning settings such as student engagement with robotics and iTunes U applications contributed positively to the development of students' learning processes and learning outcomes. More specifically, this literature review found the use of technology for learning in these settings contributed positively to gifted and talented students' approaches to self-regulated learning (e.g., Alabdullatif, 2020), their metacognition skills development and overall learning performance (e.g., Almuttairi, 2020), and their abilities to gather and evaluate facts and information (e.g., Ayoub et al., 2020).

As previously mentioned, development of gifted and talented students' skills for metacognitive thinking provides a platform for them to assume more responsibility and control over key elements of learning; namely, planning, monitoring, and evaluating performance (Almuttairi, 2020)]. To some extent, the integration of technologies for learning in gifted and talented classrooms and enrichment programs in Saudi Arabia is associated with the development of the students' skills in creative and innovative thinking. Such thinking outcomes in this context are typically defined as the thought products or processes demonstrating a balance of original and value-adding thinking (Bojulaia & Pleasants, 2021).

Furthermore, the researcher evidence suggests that integration of technology into gifted and talented classrooms in Saudi Arabia can not only enhance the delivery of content to students. That is, the technologies for learning in the classroom can support student-centred learning through the digital adaptation of learning materials – what content is being taught – and the potential for variation in learning processes – how the content is being taught (Alamrei et al., 2021). As previously established, teaching practices that best meet the different learning expectations and preferred learning styles of gifted and talented students rely on strategies to provide the learning content in ways



that engage and involve the students in the learning process (Ali & Alrayes, 2019). Based on this, technology driven differentiated instruction can facilitate the positive participation of gifted and talented students in diverse areas of the learning process including self-directed learning initiatives and collaborative learning practices (Alamrei et al., 2021; Kontostavlou & Drigas, 2019).

The integration of technologies for learning into these classrooms can play a central role in developing gifted and talented students' skills to control the learning process, to evaluate their learning progression, and to engage in collaborative learning (Almuttairi, 2020). This is because the affordances of learning technologies include supporting gifted and talented students to have more input and control over the planning, monitoring, and evaluations of their learning processes. As such, the technologies can provide these students with increased self-confidence to personalise or self-direct their learning experiences and improve the quality of their learning performance (Almuttairi, 2020).

Implications for practice in Saudi Arabia

The main general practice implication for gifted and talented education provision to emerge from a review of the research findings in this field is that technological platforms are increasingly utilised by teachers and gifted and talented students as an interactive for the exchange of ideas and information (Graham-Clay, 2015). Learning technologies can be applied in various ways for curriculum enrichment including to design learning activities, implement general exploratory learning tasks, facilitate group activities, as well as promote and support self-directed learning (Chen, Dai, & Zhou, 2013). Put simply by Vértiz-Osores et al. (2019), the integration of technology into classrooms can help teachers to create more decentralised, democratic, and equal learning environment.

The enrichment programs and differentiated curriculum approach in Saudi Arabia, and in countries all around the world, invariably have the objective to recognise a diversity of learner types and to be responsive to their diverse learning interests, preferences and needs (Westwood, 2018). The research evidence suggests that the integration of technology into the teaching and learning activities can help Saudi teachers to engage with students of different skills and ability levels to facilitate effective learning. Of particular importance, however, is that Saudi teachers of gifted and talented students have the capabilities and support to utilise learning technologies in meaningful ways to meet the expectations of gifted education programs. That is, to both promote and develop students' critical thinking skills, creativity, and capacity for meaningful self-reflection (Zimlich, 2017). Indeed, teachers of gifted and talented students in any educational setting, including Saudi teachers, rely on access to appropriate learning materials and support infrastructures to both challenge and actively involved in the processes of learning (Westwood, 2018).

It is worthwhile to also consider that Saudi teachers of gifted and talented students must not only not focus on the types of learning technologies available for implementation in gifted and talented classrooms or their abilities to use them. Consideration must also be given to Saudi gifted and talented students' 'readiness' for using technologies for learning (e.g., Potts & Potts, 2017) as well as to what Siegle (2017) refers to as the 'dark side' of learning technologies such as cyberbullying. In terms of gifted and talented student readiness for technology-based (online) learning, although such technologies can emerge as an "amazing resource for gifted students, ... the fit must be appropriate" (Potts & Potts, 2017, p. 229). As a result, Saudi teachers must guide their decisions about whether to use such technologies based on their assessments of the gifted and talented students' abilities to work autonomously, community online with teachers



and peers, and manage deadlines when completing work independently (Potts & Potts, 2017). In addition, MacFarlane, and Mina (2018) remind us of the issues related to the mismanagement of technologies for learning by teachers and students and the adverse impact this can have on student motivation for learning, learning outcomes, and sense of wellbeing. As a result, teachers of gifted and talented students must have in place strategies to address the potential for cyberbullying and the development the social-emotional awareness of students when using interactive or collaboration-based technologies for learning (MacFarlane & Mina, 2018).

This points to the importance of the Saudi MoE's focusing on the development of teachers' and students' digital skills. This will help to expand the opportunities for technology-driven differentiated instruction and the implementation of personalised learning programs in inclusive classrooms. The evidence shows that the use of technologies for learning can enable differentiated instruction by providing teachers with access to more teaching strategies on how to diversify and adapt the learning content to meet the students' different learning needs in the classroom (Alamrei et al., 2021). Therefore, for differentiated instruction and the implementation of personalised learning programs to be implemented effectively in gifted and talented teaching contexts, teachers must have at their disposal a range of teaching methods and a good understanding of the students' learning needs and preferred learning styles (Kontostavrou & Drigas, 2019). Technology-based differentiated or augmented learning materials are a feature of enrichment programs and gifted and talented classrooms to support all students to work towards the achievement of the curriculum goals which matches their skills and learning potential (Westwood, 2018)

With the support of the Saudi MoE, schools and specifically designed learning centres in Saudi Arabia need to further develop and implement policies for the provision of gifted and talented education. This will help to create and maintain a culture of support for all students to realise their learning potential and for teachers to respond to the different learning needs and interests of students (Westwood, 2018). Moreover, teachers of gifted and talented students in Saudi Arabia must be encouraged and trained in how to utilise technologies for learning to support student learning. The general reforms and initiatives being implemented in Saudi Arabia aim to improve the quality education for all students and to ensure gifted and talented children more specifically are provided with the learning programs and opportunities they need to achieve to their potential. Notwithstanding the positive research findings towards the achievements of these outcomes, it may be concluded that still more work was required to attain the national goals of gifted and talented education across Kingdom of Saudi Arabia and to ensure the provision of the right services and support and these students' learning needs.

Conclusion

The integration of technologies for learning into the learning programs designed for gifted and talented students in Saudi Arabia can provide many benefits to learners. It is generally acknowledged that a gifted and talented student, both in Saudi Arabia and in other international contexts, have a positive orientation toward the use of technology for learning. This general satisfaction technology use implies a more enjoyable learning environment for students which increases their motivation for learning and commitment to achieving learning outcomes. Moreover, appropriately selected, and integrated learning technologies in enrichment programs and for differentiated teaching can help to create more open and flexible learning environments and enhance the capacity of gifted and talented students for self-directed learning. Such technologies have been shown to provide the students with different sources of knowledge and pathways for learning to support the student to personalise or tailor the learning processes according to their needs.



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