

## Using ICTs in the education of gifted students

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### Abstract

Information and Communication Technologies (ICTs) have significantly transformed education by providing innovative teaching methods and expanding learning opportunities for all students. This paper examines the role of ICT in the education of gifted students, highlighting how digital tools such as online learning platforms, virtual classrooms, robotics, mobile learning, and virtual reality can support their unique educational needs. It also reviews the characteristics of gifted learners, the concept of giftedness, and research findings on the effectiveness of ICT-based educational approaches. The literature suggests that appropriately integrated ICT enhances creativity, critical thinking, motivation, collaboration, and personalized learning while enabling gifted students to access advanced educational resources regardless of geographical limitations. The paper concludes that ICT can play a key role in creating inclusive, engaging, and flexible learning environments that foster the full development of gifted students' abilities.

**Keywords:** Gifted Children; ICTs; Education for Gifted Children; Virtual Reality (VR); Robotics; Digital Education; Personalized Learning.

### 1. Introduction

Information and Communication Technologies (ICTs) have become an essential part of modern education, transforming the way teaching and learning take place. ICTs include digital tools such as computers, the internet, educational software, mobile applications, robotics, VR, online learning platforms that enhance access to knowledge and promote interactive learning. Their integration into education supports student engagement, collaboration, critical thinking, and personalized learning experiences. When effectively implemented, ICTs help teachers create flexible and inclusive learning environments that meet diverse educational needs. As technology continues to evolve, ICTs play an increasingly important role in improving the quality, accessibility, and effectiveness of education at all levels.

In recent years, ICT has become an integral part of the educational process; as we can see at the national and international level, it is something that is implemented as an important priority for the modernization of education, as well as a way to enhance equal opportunities of access to the educational process for all. ICT gives students direct access to knowledge in a variety of ways, through stimuli. Through the use of ICT, learning is also enhanced for gifted students as their developed skills enable them to cover even more areas of interest in a much shorter time and with greater immediacy.

Research shows that the use of ICT (Drigas et al. 2020, Karagianni et al. 2016, Kefalis et al. 2025), in the education of gifted students has particularly positive results, as using tools such as Internet platforms, digital classrooms, mobile learning, and others, gifted children can communicate with each other more easily and interact with children with similar abilities who are far away and thus do not feel isolated but that they belong to a whole.

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Technology also contributes positively to these children's learning by giving them direct access to relevant, interesting knowledge, while allowing them to further develop their knowledge and interests in their own time. Research on the effectiveness of ICT (Drigas et al. 2009, Drigas et al. 2014, Pappas et al. 2015), shows that software development and its integration into the educational environment have significant positive impacts on the lives of students and especially on gifted children.

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## 2. Definition of gifted children

In recent decades, the study of giftedness and the detailed identification of the characteristics of these individuals have been of particular interest to researchers, the scientific community, educators and parents. In the attempt to define giftedness in order to better understand it as a concept, we observe that there is a variety of definitions for it, but also a disagreement among experts as to its delimitation. It is very difficult to find a common definition, as each culture evaluates different skills as gifted (Theodoridou, 2006).

It was in America that the first foundations of the modern global educational model for the education of gifted children were laid. According to the 1972 Marland Report of the U.S. Education Office, and talented children are those who are identified by appropriately qualified professionals and who, because of their exceptional abilities, are capable of achieving high levels of performance. These are children who need different educational programs and services beyond those provided by the regular school curriculum so that they realize their contribution to themselves and to society. High performance refers to one of the following areas: general intellectual ability, specific academic aptitude, creative or productive thinking, leadership, visual and performing arts, and psychomotor ability (Marland, 1972). In addition, the United States Congress (1985) proposed to amend the Elementary and Secondary Education Act of 1965 to establish special assistance programs for gifted and talented children (United States Congress, 1985).

In 1978, the US Congress stated that bright and talented children and young people are those who, from preschool, elementary or secondary education, display abilities or potential that led to high-level performance in areas such as cognition, creativity, academics, or areas such as the visual and performing arts, and therefore need services and activities not routinely provided by schools (United States Congress, 1978). In addition, in 1978, Renzulli provided a definition in which he stated that the behavior of charismatic individuals is defined as a combination of high levels of ability, creativity, and dedication to a specific field of interest. (Story, 1991). In 1993, the Office of Educational Research and Development of the U.S. Department of Education published a report entitled «National Excellence: A case for Developing America's talent» in which the term "charismatic", introduced into the international literature by Guy M. Whipple, is replaced by the term "talented" (U.S. Department of Education, 1993).

According to the above report, children and young people with exceptional talent are those who show the potential that leads them to particularly high levels of achievement compared to other children or young people of the same age and experience or of similar environmental backgrounds. These children and young people have high levels of achievement in intellectual, creative and/or artistic areas, and possess unusual leadership ability or excel in particular academic areas. They need services or activities different from those offered in existing schools. Special talents exist in children and young people of all cultural and economic groups and in all areas of human endeavor (U.S. Department of Education, 1993).

In 2002, the definition of gifted and talented students is further amended and gifted is now defined as students, children or young people who have high potential for success in intellectual, creative, artistic or leadership-related areas, in specific academic areas that require services and activities not normally provided by schools to fully develop these abilities (National Association for Gifted Children, 2017).

Gifted and talented students demonstrate, or have the potential to demonstrate, abilities at higher levels than their peers of the same age, background, and environment across one or more areas. To fully develop their capabilities, they need adjustments to their educational experiences (National Association for Gifted Children, 2021). These students come from diverse racial, ethnic, cultural, and economic backgrounds. They must have adequate access to suitable learning opportunities to reach their full potential. May experience learning and processing challenges that require targeted support and accommodations. Benefit from guidance in both social and emotional development, alongside their talent areas (Drigas et al. 2019, Mitsea et al. 2020). The National Association for Gifted Children (NAGC) established this definition based on insights from the 2018 Definition Task Force, which compiled key considerations for identifying and supporting gifted learners (National Association for Gifted Children, 2021).

In the most recent definition in 2018, the National Association for Gifted Children (NAGC) in the USA defines gifted students as those who possess or have the potential to demonstrate abilities and talents at levels higher than their peers of the same age, experience, and environment in one or more areas (National Association for Gifted Children, 2021).

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### 3. The estimated size of the gifted population

Elite higher education institutions typically admit only talented students with high academic achievements, focusing on educating gifted children during their late adolescence. These students make a disproportionately large contribution to the national GDP. In many countries, giftedness is identified through talent search programs. On one hand, innovation and creativity are often seen as key indicators of giftedness, while on the other hand, these students are entitled to free and appropriate education tailored to their needs (Alqahtani & Alqahtani, 2021).

Estimating the exact number of gifted children in the U.S. and worldwide is challenging because it depends on the specific domains being assessed and the methods used for identification. However, a common approach is to consider children in the top 10% compared to national or local norms as a reference for recognizing and supporting giftedness. It's essential to remember that gifted children are diverse in appearance and behavior, as giftedness can be found across all demographic groups and personality types (Belanger & Gagne, 2006).

Adults play a crucial role in identifying potential and providing the necessary support to help gifted children achieve their personal best (National Association for Gifted Children, n.d.a).

The four key factors that significantly influence prevalence estimates are:

- the minimum threshold set for identification,
- the range of giftedness and talents included in the evaluation,
- whether the definition used requires multiple criteria to be met simultaneously or allows for individual strengths, and
- the degree of correlation between the different abilities being measured (Belanger & Gagne, 2006).

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### 4. Characteristics of gifted students

According to Tuttle, Becker (1980), and Heward (2011), gifted students have the following characteristics:

- Learn particularly quickly and have effective learning abilities
- Hold and retain large amounts of information because of their excellent memory and use information at a very high rate
- Curiosity and persistency
- Competence in critical and adaptable thinking
- Strong skills in generating, applying, and integrating ideas
- Leader tendencies
- Wide vocabulary
- Good judgment
- Understand the operation of large Knowledge Systems, something that typically developing children are very unlikely to understand
- Learn and manipulate abstract symbolic systems
- Solve problems by reframing the question posed to them and devise innovative solutions
- Don't compromise with superficial statements
- A deep understanding of cause-and-effect relationships
- The ability to quickly distinguish between similar, different, and unusual concepts
- Integrate complex and sophisticated knowledge
- Great sense of humor
- IQ≥130 (Tuttle & Becker, 1980; Heward, 2011)

Also, gifted children tend to reveal their abilities through noticeable behaviors even in early ages before school, and that's the reason why parents and teachers should be able to recognize behaviors and characteristics such as those mentioned above (Tuttle & Becker, 1980). Beyond traditional intelligence testing, recent research suggests that the cognitive characteristics of gifted children can also be explored through innovative assessment technologies. Virtual

reality-based assessment environments provide more realistic and interactive contexts for evaluating attention and inhibitory control, allowing researchers to observe children's cognitive functioning under conditions that closely resemble everyday situations. Such approaches may contribute to a more comprehensive understanding of gifted learners' cognitive profiles and support more individualized educational planning (Renati, Bonfiglio, Mascia & Penna, 2022).

They often have an advanced vocabulary, use metaphors and analogies, maintain focus for extended periods, and start reading at a young age. Their curiosity is evident, as is their sense of humor, quick learning, attention to detail, and strong memory. Some also display exceptional physical coordination, though they may struggle with fine motor skills, leading to frustration. These children typically develop deep and mature interests, hold strong moral values, and have vivid imaginations that enable them to create stories and songs. They are highly sensitive to environmental changes, aware of their uniqueness, and adept at linking past and present experiences. Additionally, they are attuned to the emotions and needs of others and excel in problem-solving in both social and academic contexts (Story, 1991).

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## 5. Research on the use of ICT in education

It is important to distinguish that when we refer to ICTs, we are talking about the internet, educational software and tools, while these do not include assistive technologies used by people with disabilities, such as hearing aids. (Makris & Markou, 2015). These are technologies that are directly or indirectly related to the computer, and are internationally presented as Information and Communicational Technology (I.C.T.) (Vathrakogianni, Pitsadioti & Chalioti, 2018). In addition, it is the use of technology which has the ultimate purpose of communication and information (Antypa, 2008), and the term ICT refers to technologies that help to find solutions through applications created by the combination of Information, Telecommunications and Multimedia Technologies (Vathrakogianni, Pitsadioti & Chalioti, 2018).

There is a plethora of research that supports the positive importance of ICT use in education, as it seems to help the learning process to a significant extent, while on the other hand there are studies that argue that the use of technology in the classroom can create problems (Mioduser, Nachmias, Lahav & Oren, 2000; Tassi, 2014). In early childhood education, numerous studies have shown that well-designed digital learning activities can serve as a valuable educational tool, promoting efficient and effective learning, particularly in the development of early literacy skills (Plowman, Stephen, & McPace, 2010).

Many studies agree that the effective integration of ICT into education is a particularly complex process, as it is multifactorial, with one of the key factors influencing its integration being the training of teachers in technology (Cartelli, 2006). The role of teachers is particularly important in the successful implementation of digital educational resources. Teachers need to possess adequate digital competence in order to select, adapt, and develop appropriate resources according to students' educational needs. In gifted education, teachers are expected to use technology not only as a means of presenting information but also as a tool for creating challenging learning environments that promote exploration, creativity, and deeper understanding (Khalikova & Khalikov, 2020).

The successful integration of ICT in gifted education is strongly connected with teachers' ability to adopt innovative educational practices. Teachers working with gifted learners need not only technological competence but also the ability to design learning experiences that encourage creativity, independence, and advanced cognitive development. Innovative teaching approaches allow educators to better respond to the specific characteristics of gifted students and create learning environments that support their intellectual potential (Khalikova & Khalikov, 2022).

Siegle (2004) argued that technology should not be viewed merely as a means of delivering information, but as a tool for developing new literacies, critical thinking, and problem-solving skills. Siegle (2004) emphasized that ICT is most effective when integrated into authentic learning activities that encourage gifted students to analyze, evaluate, and synthesize information rather than merely retrieve it. A wide variety of ICT applications have become increasingly accepted as developmentally appropriate education resources for children's spoken and written language development requiring, teacher assistance in some cases (Segers & Verhoeven, 2003)

Earlier, research has explored the benefits of computer-assisted instruction (CAI) as a standalone intervention for promoting reading development in kindergarten children. (Yelland, 2005). Numerous CAI programs have focused on developing phonological awareness, rhyme recognition, sound segmenting and blending, alphabet knowledge, and print concepts (Macaruso & Walker, 2008).

Furthermore, a recent study examining the effects of the PictoPal initiative—a technology-supported intervention system—reports significant learning improvements in children's understanding of written language, the connection

between spoken and written language, and their ability to engage in meaningful reading and writing activities. The findings also suggest that the PictoPal system supports literacy development—such as understanding various text types and the connection between spoken and written language—only when students receive appropriate guidance and when the digital activities are combined with related offline tasks (Saracho & Spodek, 2008).

### 5.1. The importance of using ICTs in the education of gifted students

Many of these children are introverted, and they may require specific guidance and support to develop their social skills. Gifted children may demonstrate exceptional abilities in various areas. Recognizing their giftedness and the specific domain in which they excel is the first step in applying specialized educational tools and methods for them. The National Association for Gifted Children (NAGC) (2017) has outlined practices for identifying gifted students at the district level in the USA. The process involves self-nominations and nominations from peers, teachers, parents, or others based on their observations. In classrooms, teachers use rating scales to evaluate various characteristics of giftedness. The performance of students' work portfolios in class assignments is also taken into account, including how quickly and well these tasks are completed. Detailed case studies of each selected student are conducted to confirm their giftedness. A similar process is followed in other countries and organizations as well. However, it has also been argued that separate programs for gifted students challenge the principle of equity in education, which underpins inclusive education (Alqahtani & Alqahtani, 2021).

Providing appropriate education is a crucial aspect when it comes to gifted children. One effective approach to delivering suitable education for these children could be the use of ICT tools and techniques (Alqahtani & Alqahtani, 2021). Any such method must take into account the characteristics of gifted children, which Kontostavlou and Drigas (2019) listed as curiosity, initiative, imagination, originality, creativity, dedication to their work, and a passion for learning. In this context, the role of teachers becomes particularly important, as ICT alone cannot guarantee effective learning outcomes. Teachers need to develop innovative educational strategies that combine technological resources with appropriate pedagogical approaches. According to Khalikova and Khalikov (2022), working with gifted students requires educators to continuously improve their professional skills and implement creative teaching methods that stimulate students' abilities, motivation, and active participation in the learning process.

Digital educational resources can contribute significantly to the development of gifted students by providing access to diverse learning materials, interactive activities, and flexible learning opportunities. These resources allow students to explore subjects in greater depth and support the development of independent learning skills. Through digital environments, gifted learners can access educational content beyond the limitations of traditional classrooms, which enables them to follow learning paths that correspond to their abilities and interests (Khalikova & Khalikov, 2020). Mobile learning, digital classrooms, and online discussions are some of the approaches explored in this context. However, ICT can only be effective for those gifted students who have a talent for using technology. There may be gifted students in other fields for whom ICT is not an appropriate educational tool. One benefit of using ICT to teach gifted children is that it offers them opportunities to develop and practice higher-level thinking skills (Alqahtani & Alqahtani, 2021).

Furthermore, teachers' innovative capacity and willingness to develop new pedagogical approaches are essential for ensuring that ICT contributes effectively to gifted education. Technology becomes educationally meaningful when teachers use it creatively to design learning experiences that challenge gifted learners and promote their cognitive, social, and personal development. The effectiveness of ICT in gifted education depends not only on the availability of digital tools but also on teachers' ability to integrate them through innovative and student-centered practices. In this context, digital educational resources can provide gifted students with access to diverse learning materials, interactive activities, and flexible learning opportunities that correspond to their individual abilities and interests. Through digital environments, gifted learners can explore subjects in greater depth, develop independent learning skills, and engage with advanced content beyond the limitations of the traditional classroom (Khalikova & Khalikov, 2020 & 2022). Since gifted students are located around the world, ICT facilitates communication among them, meeting the diverse needs of differently gifted children through networking (Kaur & Meenu, 2013).

Similarly, Siegle (2004) suggested that the educational value of technology lies in its ability to engage gifted learners in authentic inquiry, allowing them to evaluate information critically, construct knowledge independently, and solve complex real-world problems. Gifted students need innovative tools and methods to access knowledge more directly and quickly and stimulate their interests, something that can be achieved through ICTs (David, Kiose, Maikou, Tzelepi & Stathopoulou, 2023). According to Siegle (2004), internet technologies provide gifted learners with opportunities to access authentic resources, collaborate with experts and peers, and participate in meaningful learning experiences that extend beyond the traditional classroom. Through the use of ICT, the creation of a cultural experience (eCulture) is

achieved, through which students acquire active participation in the educational process, come into contact with new data, teaching methods, learning environments and all this contributes to improving their progress (Karagiorgi, 2010; Bourantas, 2005). ICTs are a key element in transforming, improving, and advancing the educational process, particularly in meeting the needs of gifted students (David, Kiose, Maikou, Tzelepi & Stathopoulou, 2023).

The transformation of teaching practices through technology requires teachers to move beyond traditional instructional approaches and adopt more flexible and student-centered methods. Innovative educational activities can help gifted

learners explore their interests, develop higher-order thinking skills, and participate actively in knowledge construction. Therefore, teachers' creativity and readiness to experiment with new approaches are essential elements for maximizing the educational benefits of ICT in gifted education (Khalikova & Khalikov, 2022). They also contribute to significant and substantial changes in the educational process and school reality while at the same time they enhance the cognitive development of students and give the teacher and the school as well as the educational system a much more essential role in the learning process (Nikoloudakis, 2010).

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## 6. Using VR in education for gifted children

Augmented Reality (AR) and Virtual Reality (VR) appear to be highly promising ICT tools for educating gifted children (Alqahtani & Alqahtani, 2021). Avcu and Yaman (2024) conducted a survey about the effect of VR on gifted students. The study's subject was Nature Relatedness and Attitudes Towards Environment. The participants were 27 gifted students (mean age = 12.8), including 10 boys and 17 girls. The intervention was carried out in three sessions using the Imedu VR platform, following the principles of the Cognitive Theory of Multimedia Learning. Exaggerated feedback was applied in the second session and corrective feedback in the third (Avcu & Yama, 2024). The findings suggest that integrating VR technologies in gifted education can effectively enhance students' connection to nature and positive environmental attitudes (Avcu & Yaman, 2024).

In addition to supporting instruction, virtual reality has also emerged as a valuable tool for educational assessment. VR-based assessment environments can evaluate cognitive processes such as attention and inhibitory control within realistic classroom simulations, offering educators complementary information alongside conventional psychometric assessments. These immersive assessment methods may facilitate a more comprehensive evaluation of gifted learners' cognitive functioning (Renati et al., 2022). Today, gifted students not only have access to vast amounts of global knowledge through the web, but they also experience content in more interactive ways beyond reading text or viewing images. Through virtual and augmented reality applications, they can engage with learning materials more actively. For example, 360-degree virtual videos allow students to explore a scene freely, observing it from any direction they choose (Siegle, 2018).

Because of the increase in the use of VR, there are many 360-degree videos provided by newspapers so students can have access to their news; YouTube, Facebook, Instagram, etc. also have many 3D videos; museums and galleries have made 3D tours for virtual visitors. Additionally, Google Maps uses 3D views for many roads (Siegle, 2018). Also, there are many apps that can be used by students to create their own 3D videos and photos, and many online tools that can be used to create a VR art exhibition or presentations of a project or a 3D construction model, etc. All those give gifted students the opportunity to experience the information and understand it in a different way. Many teachers have mentioned that their students have more questions and engaged in projects better when they use VR technology (Korbey, 2017; Siegle, 2018). Children often need time to develop a clear mental representation of what they are learning. Virtual reality can support this process by helping them make connections more easily, acting as both a bridge and, in some cases, a significant leap toward understanding (Korbey, 2017).

At Canakkale Onsekiz Mart University, Turkey (2018-2021), a project was developed about the use of VR in the education of gifted children (Gencel, 2020). The first output of the project was a Teacher Training Curriculum designed to support the education of gifted and talented children in inclusive classroom settings, and the second one was Virtual Reality resources featuring scenarios based on situations that future teachers may encounter when working with gifted students in their classrooms (Gencel, 2020). In the national knowledge papers prepared by the project partners on the education of gifted children in Turkey, Greece, Poland, and Spain, it became apparent that an innovative curriculum for gifted and talented education has to be a priority (Gencel, 2020). The project's findings emphasize that using 3D visual objects in teachers' training can increase their interest and motivate them. Also, VR technology can affect gifted and talented children's imagination and creativity (Gencel, 2020).

VR has the ability to make you feel that you are in another world because your brain thinks everything it experiences while in a virtual reality is real (Martens, 2020). The immersive learning experience is further strengthened through

the use of a head-mounted display, which helps learners maintain their attention and remain focused on the subject matter (Martens, 2020). VR has many advantages for teachers, such as the fact that a teacher can monitor where the students are looking; also, they can upload a variety of resources to their students' VR devices (Martens, 2020). On the other hand, students can choose how to process the information about a VR lesson, making their own flow of information according to their own way of learning (Martens, 2020). Also, they can participate in many VR school trips in many places, such as museums or other countries, landmarks, parks, even in the universe, using the Google Expeditions platform (Martens, 2020; Roushias, 2020).

A project named VR@SCHOOL that takes place in Romania aims to develop a set of online tools that support teaching practices and encourage the integration of virtual and augmented reality into classroom instruction (Romanescu & Fulop, 2020). The project also includes train-the-trainer programs and VR-based lessons for STEM subjects, which will be developed and implemented in VR laboratories across participating schools (Romanescu & Fulop, 2020). VR is providing opportunities for more realistic and immersive experiences because of the feeling of "being there" (Roushias, 2020). In addition to VR headset-based experiences, both teachers and students can also make use of advanced virtual reality systems, such as the Vive Pro, as well as standalone VR devices (Roushias, 2020). Also, VR can captivate students because it provides new experiences and types of interaction that adds value to teaching, making VR an important teaching method because it stimulates students' imagination and thinking (Romanescu & Fulop, 2020). Virtual reality is a highly influential technology with the potential to enhance and enrich learning experiences, while also transforming the way education is delivered and experienced in the long term (Romanescu & Fulop, 2020).

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## 7. The results of using ICTs in the education of gifted students

Today's students have been raised in a digital environment surrounded by mobile phones, computers, and MP3 players (Sheffield, 2007). Therefore, it is essential that their education evolves in alignment with their technological interests and progress. This digital environment has also transformed the nature of literacy. Siegle (2004) maintained that gifted students need to acquire new literacy skills, including the ability to locate, evaluate, organize, and communicate information effectively through digital technologies. The Center for Talent Development (CTD) at Northwestern University offers online programs for gifted learners, and many gifted children have been enrolled in multiple classes of these programs. The parents mentioned that the flexibility that online learning offers to their children was the most important part of this method. Some others said that their children found online learning especially engaging due to the strong instructional quality and the chance to connect with peers in an academic setting.

The reason that flexibility was thought of as the most important aspect of online classes was the fact that the children were able to choose and learn a course of their interest that was not offered by their schools or that belonged to a bigger grade level. Some other students report that the program was appealing because it helped them to construct their own timeline for the coursework (Heward, 2011). The flexibility offered by digital educational resources is particularly beneficial for gifted students because it allows them to access advanced materials and continue learning according to their individual pace. Digital resources can support both synchronous and asynchronous learning, giving gifted learners opportunities to deepen their knowledge, review complex concepts, and engage with content that may not be available within their regular school curriculum (Khalikova & Khalikov, 2020).

Another advantage those online courses had was that they allowed students whose parents were military and being transferred out of the country or having to move to take on new positions of employment, to keep up with their studies at an accelerated pace and could continue their studies despite the family's transition (Heward, 2011). The National Gifted Centre, University Kebangsaan, Malaysia tested another method at the "laboratory school", as a teaching and learning strategy for local gifted students, which was an effective model for using ICT to teach gifted students and it was presented by Bakar (2016). The concept of a digital classroom was applied, which is an innovative approach that integrates information and communication technology (ICT). Various ICT tools, such as email, social media applications, and online learning portals, were incorporated as platforms for educating gifted students. This approach offers the advantage of creating a borderless classroom, allowing gifted students to explore knowledge freely, without limitations or boundaries (Alqahtani & Alqahtani, 2021).

Such examples demonstrate that ICT-based learning environments require teachers who are capable of designing innovative educational experiences rather than simply introducing digital tools into the classroom. Teachers' professional creativity plays a key role in transforming technology into meaningful learning opportunities for gifted students. Through innovative practices, educators can provide challenging activities that correspond to gifted learners' abilities and encourage exploration, problem-solving, and independent learning (Khalikova & Khalikov, 2022).

The use of robotics can also be an excellent method to foster creativity among gifted children. This potential was demonstrated by Jagust, Cvetkovic-Lay, Sovic Krzic, and Sersic (2017) in a series of extracurricular enrichment workshops using robotics, such as Lego Mindstorms EV3, along with ICT, for gifted primary students in grades 2 to 4. The gifted students had no trouble learning complex topics in computer programming, mechanics, algorithmic thinking, robotics, problem-solving, and creativity. These children were professionally identified as intellectually gifted, being at least two mental years above average. These efforts showed that gifted children are highly creative, focused, task-oriented, fast learners, more motivated and independent, and enjoy collaborating with other gifted children who share similar interests and skills (Jagust, Cvetkovic-Lay, Sovic Krzic & Sersic, 2017).

Another kind of ICTs is online education Olszewski-Kubilius and Corwith (2011) highlighted the significance of distance learning, as ICT was found to be particularly beneficial for gifted children living in remote rural areas, or when their schools lack adequate advanced programs. It is also useful for those who struggle to adapt to the traditional school education style or for homebound students. Distance education offers the advantage of providing suitable courses to gifted children without separating them from their peers or the regular school environment, also the desire to accelerate their education and earn extra credit for courses not available at their institution can serve as motivational factors (Alqahtani & Alqahtani, 2021). Mobile learning (m-learning) enhances online learning. A notable example of combining m-learning with lesson plans and gamification was the Lesson Plan by Symbaloo EDU, gamification, and m-learning with Escape Room as a teaching alternative for English as a second language, tailored to the faster learning pace of gifted children, presented by Del Carmen Trillo-Luque, Quintero-Ordoñez, Fuentes-Gómez, and Dauder (2020).

Blachnitzky (2009) developed and tested an online gaming application, Typozilla, inspired by the features of the most popular gaming websites. Tests with gifted children showed that they were highly enthusiastic about seeing the avatars of other players in the multiplayer areas and competing with each other. They enjoyed learning the new skill of touch-typing through the game and engaging in creative tasks. All the gifted children found the application to be extremely appealing. Another instructional design developed by Avcu and Er (2020) proved effective in enhancing the computational thinking and creative thinking skills of gifted students, but did not improve their programming self-efficacy. The instruction also helped students learn and practice computational concepts and their applications, as well as develop their perspectives on computational practices and design thinking skills to a certain extent. The students enjoyed the design thinking process, learned the course content, but faced some challenges (Avcu & Er, 2020).

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## 8. Conclusion

The findings presented in this review demonstrate that Information and Communication Technologies have become valuable educational tools for supporting gifted students. ICT enables personalized learning, encourages creativity, critical thinking, collaboration, and problem-solving, while providing access to educational opportunities that are often unavailable in traditional classroom settings. Technologies such as online learning, robotics, mobile learning, virtual and augmented reality offer gifted learners stimulating environments that match their advanced cognitive abilities and individual interests. However, the successful integration of ICT depends on appropriate educational planning, teacher training, and the careful selection of digital resources that address students' diverse needs. ICT should be viewed not as a replacement for effective teaching but as a powerful complement that enriches learning experiences and helps gifted students reach their full academic and personal potential. Future research should continue to explore emerging technologies, including artificial intelligence and adaptive learning systems, to further improve educational practices for gifted learners.

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## Compliance with ethical standards

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The Authors proclaim no conflict of interest.

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