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Review

Digital Tools to Support Personalized Education for Gifted Students: A Systematic Literature Review

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Abstract

Personalized education, particularly for gifted students, has attracted increasing attention as digital tools expand opportunities to adapt learning to individual students' needs, interests, and abilities. However, the conceptual ambiguity surrounding personalization, which is often conflated with differentiation or individualization, calls for a clearer understanding of its implementation in digital environments. This study presents a systematic literature review of research published between 2000 and 2024 on digital tools for the personalized education of gifted students. Following the PRISMA guidelines, a comprehensive search was conducted in SCOPUS and Web of Science, yielding 257 initial records. After applying inclusion and exclusion criteria, a final corpus of 55 studies was analyzed through temporal, geographic, educational, and curricular perspectives. Thematic coding was also applied. The results show a marked increase in publications after 2020, with the United States and Russia as leading contributors, and a predominant focus on secondary education and STEM/STEAM disciplines. Across studies, digital tools were found to support personalization by fostering autonomy, creativity, collaboration, and advanced cognitive skills, though significant challenges remain in terms of equity, teacher training, and data security. Following this review, we conclude that although digital tools hold substantial promise for advancing personalized learning, their broader implementation requires integrative and context-sensitive strategies.

Keywords: digital learning tools; gifted and talented education; personalized learning; educational differentiation; STEM and STEAM education; teacher professional development; equity and inclusion in education; systematic literature review (SLR)

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1. Introduction

In recent years, personalized learning has received increasing attention in both educational practice and policy thanks to its potential to adapt instruction to students' needs, interests, and learning styles through the use of digital technologies. In the field of gifted education, this approach is particularly relevant, as it facilitates differentiated instruction, fosters autonomy, and promotes advanced cognitive engagement. Nevertheless, the term remains conceptually ambiguous and is often conflated with differentiation, individualization, or adaptive instruction, each of which has distinct pedagogical implications. This lack of clarity has limited the theoretical coherence of the literature and reinforces the need for a robust framework to analyze how personalization can be effectively understood and implemented in digital environments for gifted students.

To address the conceptual ambiguity noted above, we distinguish three levels along the path toward fully personalized education, following Tourón's synthesis as reported by Román-González and González Galán (2019). Individualization adjusts the pace of instruction to each learner while keeping goals and content constant for all students; learners follow a predefined pathway at different speeds. Differentiation goes further by varying methods and learning activities for groups of students with shared profiles, still keeping goals and content consistent. Personalization constitutes the most advanced form of adaptation: goals, content, pace, and methods are tailored to each learner's needs, preferences, and interests, with explicit learner agency in planning and self-evaluation (Tourón, 2013, as cited in Román-González & González Galán, 2019). In what follows, we adopt "personalized education" as the overarching lens.

These three stages can be more clearly distinguished when compared along key instructional dimensions. Table 1 synthesizes the differences, highlighting how adaptation gradually progresses from pace adjustments to methodological variation and finally to a fully tailored approach in which objectives, content, and learner agency are central.

Table 1. Differences between individualization, differentiation, and personalization.

Characteristic	Individualization	Differentiation	Personalization
Objectives and Content	Constant for all students	Constant for all students	Adjusted to each learner's needs, preferences, and interests
Learning Pace	Adapted to each student	Generally constant, with some variation	Adapted to each student
Teaching Methodology	Constant, focused on allowing different learning rates	Adaptable and varied according to the needs of student groups	Fully tailored to each learner's needs, preferences, and interests

Source: elaboration based on Tourón (2013), as reported by Román-González and González Galán (2019).

As shown in Table 1, personalization differs qualitatively from individualization and differentiation by redefining objectives and positioning the learner as an active co-designer of the educational process (Román-González & González Galán, 2019). In this review, personalized education is understood as a person-centered process that recognizes each learner's singularity and adapts at least two dimensions—goals, content, pace, or methods—while fostering learner choice and reflection (García Hoz, 1993; Calderero et al., 2014).

By contrast, differentiation adapts methods for groups while keeping goals constant, and adaptive instruction refers to algorithmic adjustment of sequencing, difficulty, or pacing based on learner data, usually without agency or co-decision (Román-González & González Galán, 2019). Adaptive systems may support personalized education, but do not guarantee it unless they embed learner agency and broader developmental aims (Calderero et al., 2014). Accordingly, only interventions meeting these criteria were coded as personalization within the review corpus, whereas interventions limited to automated adjustments of pace or difficulty without explicit learner agency were coded as adaptive instruction (Román-González & González Galán, 2019).

Personalized education is anchored in a pedagogical tradition that places the person at the center of educational action, emphasizing dignity, freedom, and integral growth (Mounier, 1949; Maritain, 1966; García Hoz, 1993). Within this framework, singularity, interiority and openness, and autonomy function as core notes guiding educational design

(Pérez Guerrero & Ahedo Ruiz, 2020; Calderero et al., 2014). Complementary theoretical lineages provide mechanisms for enactment: progressive and constructivist perspectives emphasize experiential learning and active knowledge construction (Dewey, 2019; Montessori, 1949; Piaget, 1981; Pozo, 1989), while sociocultural theory highlights the zone of proximal development and scaffolding as foundations for guided progression and the gradual release of responsibility (Vygotsky, 1978; Wood et al., 1976; Pérez-Pueyo et al., 2019). Historical organizational innovations such as the Dalton Plan, the Winnetka Plan, and Dottrens' fiche system normalized flexible pacing, learner responsibility, and method variation (Parkhurst, 1922; Washburne, 1922; Dottrens, 1927). Contemporary digital tools can thus be interpreted as affordances to implement these principles at scale—enabling fine-grained tailoring, expanding learner agency, and fostering authentic openness to others and reality—rather than as mere technological adjustments (Calderero et al., 2014; Román-González & González Galán, 2019).

There is growing evidence that adaptive platforms and apps can enhance skills such as creativity, autonomy, and critical thinking in gifted students (Dimitriadou et al., 2024; Shubina & Kulakli, 2019; Vouglanis, 2018). However, significant barriers remain, such as unequal access to technology in developing countries, which restricts the implementation of these tools in marginalized contexts (Isusqui et al., 2023, p. 32). These tensions illustrate both the potential and limitations of digital tools when aligned—or misaligned—with the core principles of personalized education. To avoid reducing personalization to mere technological adaptation, it is necessary to analyze how digital innovations can be meaningfully integrated with pedagogical practices that respect learners' uniqueness and autonomy and the holistic growth of gifted students.

Against this backdrop, this systematic review examines how digital tools enhance personalized learning for gifted students, identifying both successful practices and persisting challenges. The main objective is to systematically review the literature on digital tools for the personalized education of gifted students, identifying key trends, benefits, and challenges. More specifically, this review (1) analyzes the evolution and distribution of studies across time, geography, educational stages, and curricular areas; (2) identifies the main approaches, practices, and benefits associated with the use of digital tools for personalized learning in gifted education; and (3) examines the challenges and complementary contributions—such as teacher training, talent identification, and guidance—that affect the effective implementation of digital personalization. This review is necessary because, despite the growing use of digital tools in education, research on their role in gifted education remains fragmented, conceptually inconsistent, and geographically uneven. By clarifying the foundations of personalized education and connecting them with emerging digital practices, this study provides an integrative perspective that can inform future research, guide educators in practice, and support policy decisions aimed at equity and excellence in gifted education. To the best of our knowledge, this is the first systematic review that specifically examines the role of digital tools in supporting personalized education for gifted students, thereby addressing a significant gap in the international literature.

This review was guided by the following research questions:

RQ1. How has scientific research on digital tools for the personalized education of gifted students evolved across time, geography, educational stages, and curricular areas?

RQ2. What approaches, practices, and benefits are associated with the use of digital tools for personalized learning in gifted education?

RQ3. What challenges and complementary contributions (e.g., teacher training, talent identification, guidance) influence the effective implementation of digital personalization for gifted students?

In line with these questions, this review proceeded from the preliminary assumption that research on digital personalization in gifted education is fragmented and geographically uneven, with limited integrative perspectives. It was also assumed that digital tools are predominantly studied as vehicles for adapting pace and content, whereas their potential to support broader dimensions of personalized education—such as autonomy, creativity, and learner agency—remains less systematically explored.

2. Method

A preliminary search in major databases (SCOPUS, WOS, ERIC, ProQuest, and Google Scholar) and in repositories of systematic reviews (PROSPERO, Campbell Collaboration, and OSF Registries) revealed no systematic reviews directly addressing digital tools for the personalized education of gifted students. Existing reviews focus either on general educational technology, personalization without reference to gifted populations, or gifted education without addressing digital personalization specifically. This gap justifies the present study.

The methodology followed the protocol of Torres-Torres et al. (2021), which emphasizes a rigorous multi-phase process of identification, screening, eligibility, and inclusion of studies. In addition, the review was conducted in alignment with the PRISMA 2020 guidelines (Page et al., 2021), which provide a 17-item checklist to ensure transparency, completeness, and methodological rigor in systematic reviews. Furthermore, the recommendations of Estarli et al. (2016) were applied, highlighting the need to define clear research questions, design structured search strategies, and apply explicit inclusion and exclusion criteria to minimize bias.

This review was not registered in PROSPERO, since this registry is restricted to health and biomedical reviews. However, the process adhered to the same standards of rigor, clarity, and replicability required in registered systematic reviews.

2.1. Search Strategy

The search was conducted between January and March 2024. The primary databases used were SCOPUS and Web of Science (WOS), as they provide the most comprehensive coverage of peer-reviewed international literature in both education and technology and are considered standard sources for systematic reviews in education. To ensure that no relevant studies were overlooked, exploratory searches were also performed in ERIC, ProQuest Education Database, and Google Scholar. However, these sources did not yield additional records meeting the inclusion criteria; therefore, the final corpus was drawn exclusively from SCOPUS and WOS. The search equation was defined as gifted* AND (different* OR individual* OR personal* OR educat*) AND digital*.

This query was applied in SCOPUS and WOS with filters by document type (articles, reviews, book chapters, and conference papers), language (English and Spanish), and time span (2000–2024). This starting year was chosen because systematic diffusion of online platforms and virtual learning environments in education began around 2000, ensuring that the review captured the development of digital personalization from its early stages to contemporary approaches.

Subsequently, the PICOC framework (Population, Intervention, Comparison, Outcome, Context) was employed as a structured method to refine the selection. The population was gifted students (gifted*), the intervention was personalized education/learning (different*, individual*, personal*), the outcome was digital tools (digital*), and the context was education (educat*). No explicit comparison was applied, given the exploratory nature of the study.

2.2. Study Selection

The initial search yielded 257 records (143 in WOS and 114 in SCOPUS). After removing 75 duplicates, 182 records remained. Titles, abstracts, and keywords were screened jointly and in consensus by two of the authors, resulting in the exclusion of 107 records. At this stage, 75 records were considered potentially relevant.

A third author independently reviewed the 75 records and suggested the exclusion of two studies that did not meet the research focus. After consensus among all authors, these were removed, leaving 73 studies to be assessed at the full-text level. Of these, 73 (97.3%) were retained, yielding an observed agreement rate of 97.3% and a Cohen's Kappa of 0.94, which indicates almost perfect agreement (Landis & Koch, 1977).

At this stage, a new inclusion criterion (CI2) was introduced: full-text availability. Applying this filter resulted in the exclusion of 15 records without the full text accessible. The remaining 58 studies were reviewed in their entirety. After full-text reading, 3 articles were excluded because, despite appearing relevant at the abstract level, they were not aligned with the focus on gifted education, digital tools, and personalized learning, as established by the PICOC framework. The final corpus consisted of 55 studies (Final corpus 55 articles.pdf). Each study corresponded to a single published document, which means that the number of studies included (n = 55) and the number of reports of included studies (n = 55) coincided. The selection process is summarized in Figure 1 (PRISMA 2020 flow diagram of the study selection process).

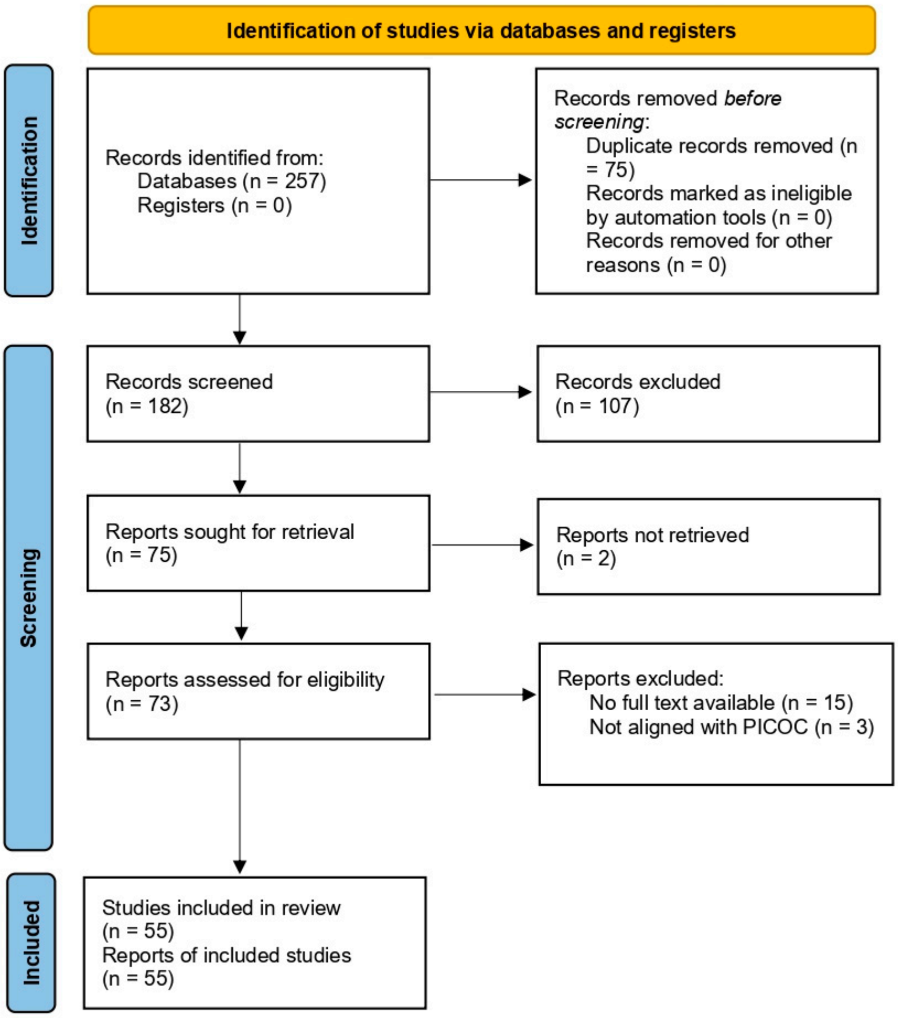

Figure 1. PRISMA 2020 flow diagram of the study selection process.

2.3. Review Process and Coding

Review and coding were carried out collaboratively to ensure methodological rigor and transparency. Two authors conducted the full-text review and initial coding in parallel, using matrices specifically designed in Excel to record decisions and classifications. Discrepancies were discussed until consensus was reached, and a third author was involved in cases requiring clarification. This triangulated procedure reinforced the reliability of the process and the consistency of the data extracted.

The coding framework combined deductive and inductive strategies. Deductively, it was structured around five predefined dimensions: (1) temporal distribution, (2) geographic distribution, (3) educational stage and curricular area, (4) main topics and approaches to personalization, and (5) reported benefits and challenges. Inductively, additional categories emerged during the analysis, such as teacher training, talent identification, and educational guidance.

For each of the 55 studies, bibliographic and descriptive information (year, journal, and country), methodological features (study type, sample, and context), intervention details (digital tools employed, Appendix A), degree of integration, and pedagogical objectives) were systematically coded. Educational benefits and challenges were also extracted, along with the degree of personalization, distinguishing between interventions that leaned toward individualization, differentiation, or full personalization. Final coding decisions were validated collectively by the authors. This process produced a robust analytical framework that ensured consistency across the corpus and laid the foundation for the results section, where temporal trends, geographical patterns, thematic foci, and educational benefits and challenges are systematically examined.

2.4. Quality Assessment

As shown in Table 2, the quality appraisal indicated a balanced distribution between qualitative (39.3%) and mixed-method designs (41.1%), with fewer quantitative studies (17.9%) and one contribution with an unspecified classification (1.8%). This distribution highlights the predominance of descriptive and exploratory approaches, complemented by some triangulated methods, while purely experimental evidence remains limited. Although the appraisal was not applied as an exclusion criterion, it informed the synthesis and weighed the relative strength of the findings discussed in the review.

Table 2. Distribution of included studies by research design.

Research Design	Number of Studies	% of Total	Examples of Methods Reported
Mixed-method	23	41.1%	Questionnaires + log-file analysis, surveys + case studies
Qualitative	22	39.3%	Interviews, case studies, observations, vignettes
Quantitative	10	17.9%	Surveys, pre–post tests, comparative analyses
Unspecified/Other	1	1.8%	Labeled as "Study Type (quantitative, qualitative, mixed)"

Source: elaboration based on the file Coding Plan and Analysis.

In addition, inter-rater reliability was established through a process in which two authors independently coded the studies, with a third author resolving any discrepancies. Agreement between coders was high, with an observed agreement rate of 97.3% and a Cohen's κ = 0.94, indicating almost perfect agreement (Landis & Koch, 1977). This strengthens the robustness of the quality appraisal presented in Table 2.

3. Results

This section analyzes the results obtained in this study, which were structured into seven complementary perspectives: temporal, geographic, educational stages, curricular areas, personalization approaches, educational benefits, and implementation challenges. These perspectives were selected because they allow the review to capture not only the chronological development of the research and its geographical distribution but also how studies focus on different levels of education and curricular domains. In addition, by examining personalization approaches, reported benefits, and persisting challenges, this review provides a comprehensive framework to evaluate the extent to which digital tools are contributing to the personalization of learning for gifted students.

3.1. Temporal Analysis

Temporal analysis of the corpus revealed an absence of studies on digital tools in the education of gifted students until 2005. From that year onwards, interest began to emerge gradually, though it remained moderate. A significant turning point occurred in 2020, coinciding with the COVID-19 pandemic and the rise in online education, which accelerated the adoption of digital technologies in schools. While this context boosted digitization, it also exposed deficiencies in training and resources (Soboleva et al., 2022). Importantly, studies conducted during the pandemic often focused more on students' reactions to the sudden use of technology rather than on the intentional development of personalized approaches. Since 2020, interest in the subject has been maintained at a high and sustained level, suggesting that the pandemic acted as a catalyst for long-term research attention (Figure 2).

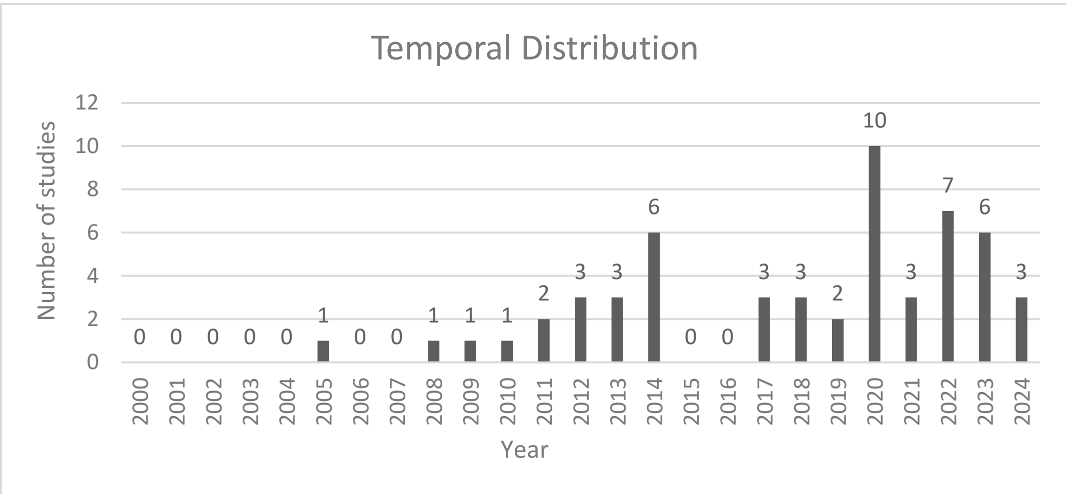

Figure 2. Temporal distribution of studies on digital tools for personalized learning in gifted education (2000–2024).

3.2. Geographic Analysis

The geographic distribution of the publications shows a clear predominance of studies from the United States, reflecting the nation's significant investment in science, technology, and educational innovation. Russia also stands out, with studies that emphasize technological development and innovation in education. Spain is represented by a single study (Román-González, 2014), which explored the use of apps as curricular enrichment for talented students, but since 2020, no further advancement has been observed in this field. Other countries with only one study include Greece, Croatia, the United Kingdom, Vietnam, Belgium, Mexico, China, and the Netherlands.

Overall, most of the research originated in North America (particularly the USA) and Europe (notably Russia and Austria), with occasional contributions from Asia (Turkey, China, and South Korea) and Latin America (Brazil). This distribution highlights an important imbalance and the need to extend research in underrepresented regions, such as Spain, Latin America, and parts of Africa, in order to broaden cultural and educational perspectives on personalized learning (Figure 3).

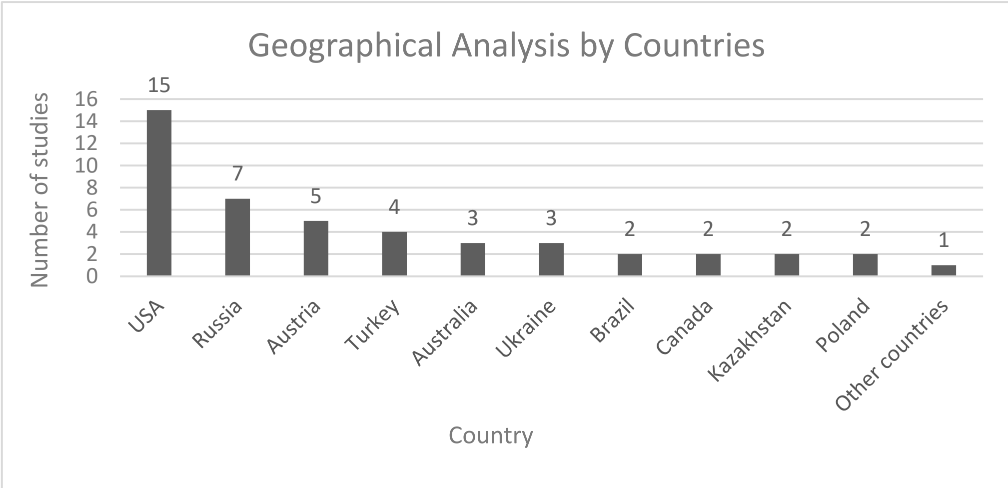

Figure 3. Geographic distribution of studies on digital tools for personalized learning in gifted education.

As illustrated in Figure 3, this imbalance has significant implications for generalizability. Findings originating mainly from the United States and Russia reflect educational systems with substantial investments in digital infrastructure and gifted education policies, which may not be representative of contexts with different resource levels, teacher preparation, or cultural understandings of giftedness. Prior research has shown that educational findings grounded in geographically limited samples often fail to generalize to broader contexts (Hanushek, 2021). Consequently, while the existing literature offers valuable insights, its applicability to underrepresented regions remains constrained, underscoring the need for comparative research that captures a wider diversity of educational realities.

3.3. Educational Stage

Analysis by educational stage shows a strong concentration of research at the levels of primary and secondary education. Early childhood education is scarcely represented, with only one study in the corpus. This is striking given the recognized importance of early development and may reflect concerns regarding the effects of early screen exposure. Primary education appears in 25 studies, demonstrating an interest in introducing digital personalization strategies in the initial years of schooling. Secondary education is the most represented stage, with 37 studies, which suggests that adolescence is perceived as a particularly favorable period for the adoption of digital tools and the personalization of learning. Finally, higher education appears in 10 studies, a relatively low number, likely due to the greater autonomy of university students and the distinct dynamics of personalization at this level. In general, the evidence reveals a predominant focus on secondary and primary education, with early childhood and higher education remaining underexplored (Figure 4).

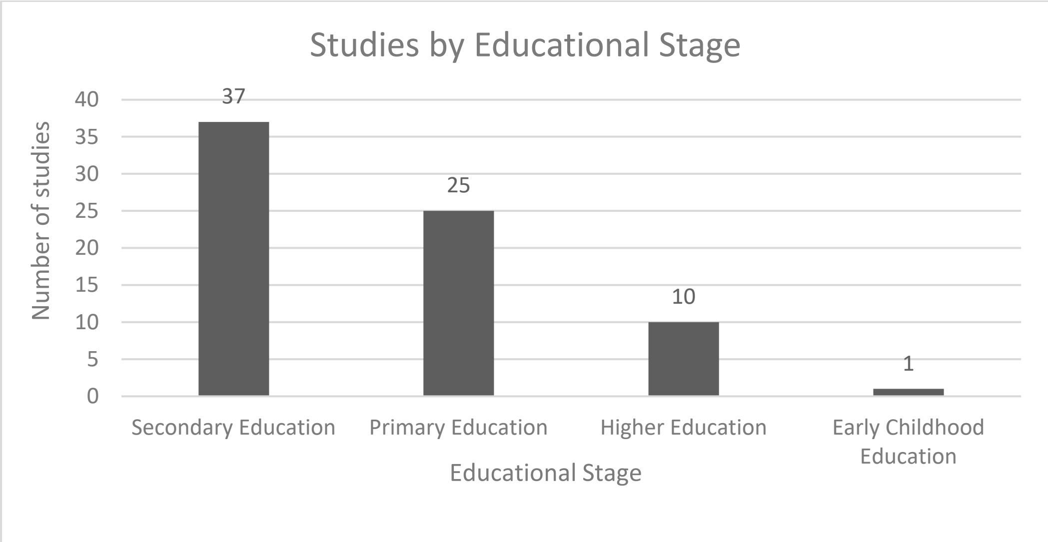

Figure 4. Distribution of studies by educational level (early childhood, primary, secondary, and higher education).

3.4. Curricular Areas

Regarding curricular domains, 13 studies adopt a transversal approach covering all subject areas, suggesting that many digital tools are designed to be broadly applicable. STEAM disciplines (science, technology, engineering, arts, and mathematics) are the most represented specific area, with eight studies, showing their central role in innovation, global competitiveness, and institutional support. Within STEAM, informatics and technology are especially prominent (six studies), reaffirming their importance as both subjects in themselves and vehicles for implementing and evaluating personalized approaches. Mathematics and science appear in four studies each, consistent with their traditional link to gifted education.

Other disciplines are less represented but provide important signals. Pedagogy, chemistry, personal development, and reading and comprehension each appear in two studies, while fields such as English, law, physical education, and writing are covered by a single study. This panorama evidences a strong emphasis on STEAM and technology, driven by labor market demand and institutional priorities. However, it also underscores the need to expand research into the arts, humanities, and social sciences, which are currently underrepresented. Diversifying curricular approaches would allow for a more balanced and inclusive form of personalization, promoting the holistic development of gifted students and broadening the impact of digital tools beyond the most technical domains (Figure 5).

Taken together, these descriptive patterns suggest that research on digital personalization remains concentrated in certain contexts, stages, and disciplines, which constrains the breadth of evidence and limits cross-context comparisons.

3.5. Personalization Approaches

The reviewed studies reveal a variety of ways in which digital tools support personalized learning for gifted students, emphasizing the adaptation of educational processes to individual profiles, interests, and abilities. Renzulli et al. (2014), for instance, highlight the Renzulli Learning System[1], a platform designed to create individual electronic profiles and recommend tailored resources. This system, rooted in the Enrichment Triad Model, illustrates how personalization can extend beyond mere acceleration to integrate students' strengths and interests while reducing teacher workload through automated resource identification.

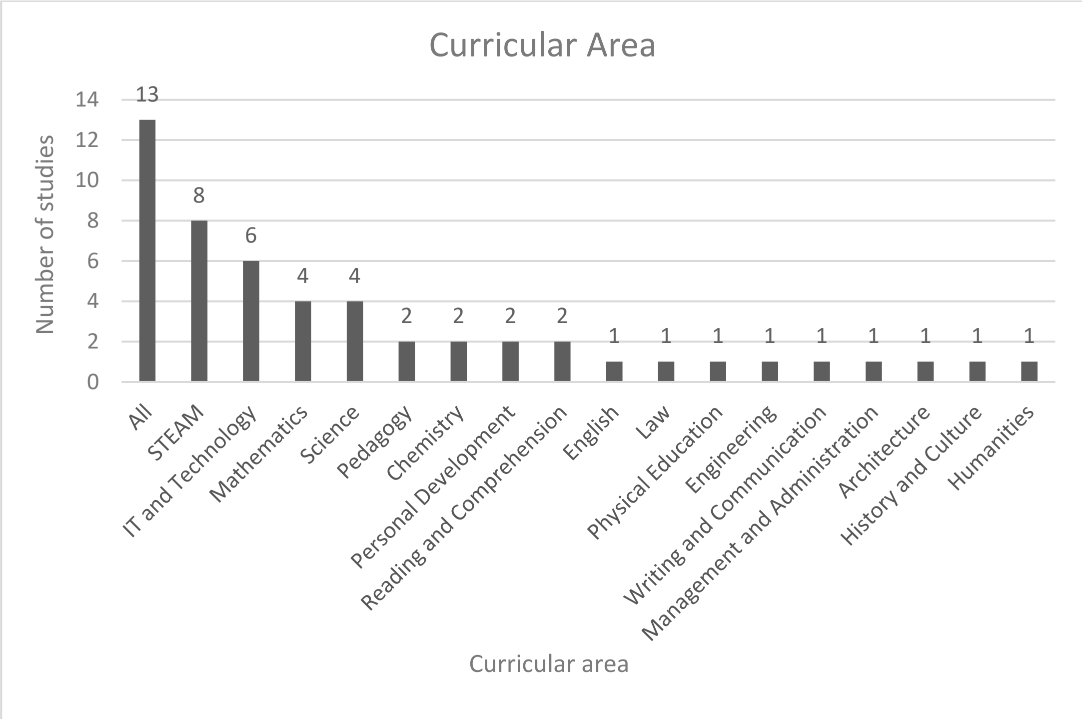

Figure 5. Distribution of studies by curricular area in personalized learning with digital tools.

Other studies underscore self-organization and interdisciplinarity as key dimensions of personalization. Bel and Jarque Fernandez (2014) stress the importance of fostering autonomy, critical thinking, and problem-solving by enabling students to set their own pace and connect knowledge across disciplines. These approaches are enhanced by digital platforms, which provide flexible access to resources and collaborative environments that simulate real-world problem-solving. Similarly, Zambo (2009), drawing on Vygotskian theory, shows how personalization through digital tools allows learners to advance within their zone of proximal development by engaging in projects aligned with their interests, which are often expressed through multimodal outputs such as blogs, videos, or multimedia presentations.

Several contributions also stress the importance of learning environments that promote independence and creativity. Karpova et al. (2020) conceptualize personalization as a learner-centered process in which students critically use information and develop their talents through interactive digital resources. Ronksley-Pavia and Neumann (2022) and Hazin et al. (2023) emphasize the teacher or tutor as a mentor who guides learners' progress while adapting tasks to their strengths. Similarly, Lamb and Aldous (2014) highlight e-mentoring programs as effective strategies to provide tailored guidance that transcends spatial and temporal limitations, fostering responsibility and conscious action. Collectively, these approaches demonstrate that digital tools can strengthen personalization when combined with pedagogical practices that respect learners' uniqueness, autonomy, and openness to growth.

3.6. Educational Benefits

The synthesis of studies highlights multiple benefits of digital tools in personalizing learning for gifted students. A recurrent theme is the personalization of content and pace: digital platforms adapt learning trajectories to individual profiles, preventing demotivation and sustaining engagement (Renzulli et al., 2014; Eysink et al., 2020). It is worth noting that many of these reported benefits are drawn from qualitative or mixed-method studies (see

Section 2.4, Table 2), which provide valuable insights but limit generalizability compared to the few available quantitative designs. Flexibility and self-regulation are supported through access to resources at any time and place (Román-González, 2014), while gamification elements and interactive simulations enhance persistence and curiosity (Ozdemir, 2022; Soboleva et al., 2022).

Beyond individualization, digital tools foster collaboration in innovative environments in which gifted students can engage with intellectual peers, strengthening not only communication and leadership but also the social–emotional benefits of working with like-minded learners (Zverev & Sergeeva, 2020; Gilson & Lee, 2023). These environments promote both advanced cognitive skills and essential interpersonal competencies, illustrating that personalization is not solely an individual endeavor but also a collective one.

Digital platforms also enrich assessment practices. Real-time analytics and adaptive feedback provide detailed insights into performance, enabling educators to tailor instruction and maximize each student's potential (Besnoy et al., 2012; Azbel et al., 2020; Golubeva et al., 2022). Moreover, access to vast digital resources supports the acquisition of advanced digital literacy, preparing students for complex academic and professional contexts (Hinterplattner et al., 2019, 2021).

Importantly, digital environments enhance inclusivity by accommodating diverse learning styles and offering pathways that adapt to different talents and cultural backgrounds. Some studies even point out that these platforms can facilitate culturally responsive teaching, integrating diverse perspectives into instructional design and ensuring equity in multicultural contexts (Hazin et al., 2023; Dillon, 2010). This makes personalization not only a pedagogical imperative but a social one as well, aligned with broader goals of educational equity.

Finally, digital tools play a crucial role in supporting interest in STEAM areas. By offering interactive and engaging content, they make these disciplines more accessible, particularly for gifted students who benefit from exploratory and inquiry-based approaches (Román-González, 2014; Hinterplattner et al., 2021; Schwinghammer et al., 2023). Although limitations exist in replicating hands-on laboratory experiences online, many platforms successfully complement such activities, sustaining students' interest in scientific and technological fields. However, the same tools can also entail risks: platforms that enhance autonomy and engagement may, in the absence of adequate pedagogical scaffolding, foster distraction or superficial learning (Kara, 2019; Ozdemir, 2022).

3.7. Implementation Challenges

Despite the significant benefits, several challenges constrain the effective integration of digital tools in personalized education. Inequitable access to infrastructure and a reliable internet connection remains one of the most pressing obstacles, particularly in disadvantaged contexts in which technological gaps hinder participation (Kalemis, 2014; Portela & Garcia Fernandez, 2018). Teacher training is another recurrent challenge: while platforms such as the Renzulli Learning System demonstrate the potential of personalization, their success depends on educators' ability to meaningfully integrate them into practice (Renzulli et al., 2014). Similarly, Ozdemir (2022) warns that activities must be carefully calibrated to avoid disengagement among gifted students, a challenge echoed in studies highlighting the need for more discipline-specific preparation and training in the use of platforms such as Office 365, Kahoot[2], or Quizizz[3] (Zverev & Sergeeva, 2020; Ibragimova & Ponomareva, 2020).

Concerns regarding data privacy and security also persist, especially as cloud-based systems become ubiquitous. Although some of the evidence dates back several years, these issues remain highly pertinent: the rapid expansion of online learning environments has only amplified the urgent need to safeguard sensitive data (Kalemis, 2014; Portela

& Garcia Fernandez, 2018). In addition, socioeconomic and cultural barriers strongly influence adoption, with inequalities often reinforced rather than reduced when adequate equity-oriented policies are absent (Mastroberti, 2020; Kelly & Pohl, 2015).

Beyond these systemic challenges, the literature also points to the importance of talent identification and educational guidance in digital contexts. Innovative methods such as fuzzy logic systems or ICT-based assessments extend beyond traditional IQ tests, enabling more individualized developmental trajectories for gifted students (Bektenova et al., 2022; Su, 2020). Likewise, online platforms increasingly serve as spaces where gifted students explore academic and career pathways, but risks such as multitasking and distraction can reduce learning efficiency if not carefully managed (Kara, 2019; Mercimek et al., 2020).

Addressing these interconnected challenges requires a comprehensive approach that combines infrastructure investment, professional development, equity-oriented policy, culturally responsive strategies, and robust guidance systems. Without these, the potential benefits of digital personalization risk being unevenly distributed, privileging certain contexts while excluding others.

Taken together, these challenges highlight that the effective use of digital tools in gifted education cannot be reduced to technical adoption alone but requires structural, pedagogical, and cultural commitments. This recognition paves the way for the synthesis of the implications of these findings for research, practice, and policy.

Overall, the evidence portrays digital personalization as a promising but unevenly substantiated field. Consistent benefits are reported for autonomy, engagement, and collaboration, yet the limited diversity of research designs and contexts reduces the strength of causal claims. Reported advantages also coexist with persistent risks—equity gaps, privacy concerns, or teacher preparedness—that condition their effectiveness. These findings stress the importance of interpreting results with caution and pursuing more rigorous comparative and longitudinal studies.

4. Discussion and Conclusions

This systematic review examined how digital tools support personalized education for gifted students, synthesizing evidence across temporal, geographic, educational, and thematic dimensions. The findings show that while digital technologies open opportunities for tailoring instruction to students' strengths, interests, and learning rhythms, their impact remains uneven and context-dependent.

Digital platforms and adaptive resources have proven effective in fostering autonomy, creativity, collaboration, and advanced cognitive engagement. Yet, barriers related to equity of access, teacher readiness, and cultural responsiveness persist, limiting their widespread impact. These tensions underscore that digital personalization is not simply a matter of adopting technology; it requires integration with robust pedagogical frameworks, culturally responsive practices, and supportive educational policies (Hazin et al., 2023).

A key implication of this review is the need to expand research beyond overrepresented contexts (such as the United States and Russia) and domains (particularly STEM), towards more diverse sociocultural settings and disciplines, including the arts and humanities. This broader lens would allow for a more inclusive and balanced understanding of how personalization through digital tools can support holistic development in gifted education (Dillon, 2010).

The quality assessment indicates that most contributions are qualitative or mixed-method studies, with relatively few quantitative studies and very limited experimental designs. This imbalance means that the evidence base offers valuable descriptive insights but provides only modest support for strong causal claims, reinforcing the need for more rigorous and diverse research designs.

For practitioners, the evidence suggests that digital personalization is most effective when teachers assume leadership roles in designing and guiding digital learning experiences that scaffold autonomy, foster collaboration, and integrate platforms into coherent pedagogical practices (Ronksley-Pavia & Neumann, 2022). Professional development should therefore focus not only on technical skills but also on strategies for cultivating learner agency, critical reflection, and social–emotional growth.

For policymakers, the findings underscore the importance of ensuring equitable access to infrastructure, safeguarding data privacy, and promoting culturally responsive strategies (Kalemis, 2014; Portela & Garcia Fernandez, 2018). Policies should encourage investment in underrepresented regions and disciplines while supporting the integration of digital personalization within broader gifted education frameworks. Without these systemic supports, the potential benefits of digital personalization risk being unevenly distributed, privileging certain contexts while excluding others.

Future research should address underexplored areas, such as the long-term effects of digital personalization on resilience, creativity, and social contribution, as well as the design of culturally responsive and equity-oriented interventions. Longitudinal and comparative studies will be especially valuable in clarifying not only the effectiveness of specific tools but also their capacity to sustain meaningful learning over time.

In summary, digital tools hold significant promise for advancing personalized learning for gifted students, but realizing this potential requires moving beyond isolated practices towards systemic approaches that integrate pedagogy, policy, and technology. By doing so, digital personalization can contribute to a more equitable and forward-looking education that nurtures the talents of gifted learners in the 21st century.

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Appendix A

Table A1. A summary of the digital tools and platforms used in the reviewed studies.

Tool/Platform	Short Description	URL
Renzulli Learning System	Personalized profiles and enrichment activities	https://renzullilearning.com
BE COOL!	Digital learning environment for gifted inclusion	https://doi.org/10.1007/s11423-020-09754-9 (accessed on 13 June 2025)
Scratch	Block-based coding platform	https://scratch.mit.edu
Kodu Game Lab	3D game design for education	https://www.kodugamelab.com
LEGO Mindstorms EV3	Robotics kit for STEM learning	https://www.lego.com/mindstorms
Arduino	Open-source electronics platform	https://www.arduino.cc
CindyJS	Math and interactive visualizations (JS)	https://cindyjs.org
GeoGebra	Dynamic math software	https://www.geogebra.org
TinkerPlots	Data visualization for students	https://www.tinkerplots.com
WISEngineering	Online environment for engineering projects	http://wiseengineering.org
Google Classroom	Learning management platform	https://classroom.google.com
Padlet	Collaborative digital boards	https://padlet.com
Flip (Flipgrid)	Short video-based learning	https://flip.com
OBS Studio	Open-source video recording and streaming	https://obsproject.com
YouTube	Video sharing and learning resource	https://www.youtube.com
DAWs (Ableton, FL Studio, Logic Pro)	Music production software	https://www.ableton.com/https://www.image-line.com/https://www.apple.com/logic-pro
Microsoft 365 (Word, PPT, Excel)	Productivity suite	https://www.microsoft365.com
Kahoot	Gamified quizzes	https://kahoot.com
Quizizz	Interactive quizzes	https://quizizz.com
LearningApps.org	Interactive learning activities	https://learningapps.org
Google Forms	Online surveys and quizzes	https://forms.google.com
Excel	Spreadsheet and data analysis	https://www.microsoft.com/excel
Open Journal Systems (OJS)	Open-source journal publishing	https://pkp.sfu.ca/ojs
3D printers, robotics, modeling tools	STEAM education technologies	—
Digital Labs (Quant Kuban-KubSTU)	Digital lab environment (Russia)	—
VR + Haptic devices	Virtual reality and tactile feedback	—
Virtual Traditional Room (Vietnam)	VR school heritage project	—
Infographic and ICT apps	Mobile/cloud-based visual learning tools	—

Notes

1 https://renzullilearning.com/.

[2] https://kahoot.com/.
[3] https://quizizz.com/.

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