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Continuities and Transformations in Identifying Gifted Students: The Role of Technology and Equity

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ABSTRACT

Gifted education has historically relied on narrow definitions of ability, often equating giftedness with high IQ scores and standardised test performance. While these measures provide clear benchmarks, they have been widely criticised for overlooking creativity, socio-emotional skills, and culturally diverse expressions of talent. The purpose of this research was to explore the continuities and transformations in gifted identification, with particular attention to the role of technology and equity. Specifically, the research asked how traditional markers of giftedness have persisted, how technological innovations have transformed identification practices, and what ethical and inclusivity challenges accompany these changes. Methodologically, the research adopted a qualitative desk research approach. A systematic review of scholarly publications, policy documents, and empirical studies published between 2015 and 2025 was conducted, complemented by key historical works. Thematic analysis was used to trace patterns of continuity, innovation, and ethical concern. The findings revealed that cognitive ability, creativity, problem-solving, and teacher judgment remain central in identification practices, reflecting their deep institutional embeddedness. At the same time, dynamic assessments, AI-driven adaptive platforms, and psychometric modelling represent a significant shift toward more individualised and process-oriented approaches. However, without safeguards, these innovations risk perpetuating inequities. It was concludes that gifted identification must be reframed as both a technical and ethical endeavour. Its contribution lies in offering a conceptual framework that balances innovation with equity, guiding policymakers and educators toward more inclusive and culturally responsive practices.

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INTRODUCTION

Giftedness has long been recognised as an essential educational concern because students with exceptional abilities often require different kinds of support from their peers. Properly identifying gifted learners is crucial not only for their personal growth but also for the broader development of societies that depend on innovation, leadership, and creativity. Across cultures, children who demonstrate unusual intellectual, creative, or leadership potential are often seen as resources for future progress (Piirto, 2016). When their abilities are nurtured, these learners frequently contribute to advances in science, technology, the arts, and civic leadership. Conversely, when they are overlooked or misunderstood, their potential may remain untapped, resulting in personal frustration and a collective loss of talent (Reyes, 2024). This dual possibility underscores the importance of accurate and fair systems of gifted identification. Historically, efforts to define and measure giftedness have been shaped by evolving conceptions of intelligence and ability. Early models, most famously spearheaded by Terman and others in the early twentieth century, equated giftedness primarily with high intelligence quotient (IQ) scores (Warne, 2019). This approach offered a seemingly objective benchmark: children scoring above a certain threshold could be classified as gifted, while others were not. While influential, such models reduced giftedness to a narrow dimension of cognitive functioning, excluding creative, socio-emotional, and cultural expressions of talent (Papadopoulos, 2020). Over time, scholars and practitioners broadened the definition, incorporating creativity, leadership, and artistic ability, as seen in frameworks like Renzulli's three-ring conception of giftedness and Gardner's theory of multiple intelligences (Alshamsi, 2024; Gil Jr, 2025; Renzulli, 2021). Despite these expansions, the shadow of the IQ-centric model continues to influence many identification practices around the world.

The heavy reliance on IQ and standardised academic tests presents serious challenges. First, these instruments often fail to capture the multidimensional nature of giftedness. Students who excel in problem-solving, leadership, or artistic domains may not perform at the highest levels on conventional cognitive measures. Second, traditional tests are prone to cultural and linguistic bias. Children from culturally, linguistically, and economically diverse (CLED) backgrounds frequently score lower, not because of lower ability but because the tests do not reflect their cultural knowledge or learning experiences (Butterfield,

2021). This has contributed to the persistent underrepresentation of minority and disadvantaged groups in gifted education programs. Moreover, traditional methods tend to view giftedness as a fixed trait rather than a developmental potential. A one-time score on an IQ test or academic measure may overlook students whose abilities emerge later or who thrive in enriched environments (Sternberg & Desmet, 2023). By equating giftedness with static performance indicators, traditional approaches risk reinforcing inequities and neglecting the dynamic, evolving nature of human talent (Alshamsi, 2024). These shortcomings highlight the urgent need to rethink how giftedness is identified to make systems more accurate, inclusive, and responsive.

Recent developments in technology offer new tools for reimagining gifted identification. Adaptive learning platforms, artificial intelligence (AI), and psychometric innovations now make it possible to evaluate students in more dynamic and individualised ways. Rather than providing a single snapshot of ability, these systems can track learning progress over time, adjusting tasks to match a learner's pace and highlighting unique strengths. For example, AI-driven assessments can detect patterns of problem-solving, persistence, or creativity that may not be captured through traditional tests (Saputra et al., 2024; Suazo-Galdames & Chaple-Gil, 2025). Neuroscience and big data also provide promising avenues for identifying exceptional abilities in areas like spatial reasoning or musical aptitude, which have historically been undervalued in IQ-focused models (Fair et al., 2021; Lubinski & Benbow, 2021). Yet alongside these opportunities come new ethical challenges. AI systems, if trained on biased datasets, may replicate and even amplify existing inequities. Students from privileged backgrounds often have greater access to enriched learning environments, digital resources, and test preparation, meaning that algorithms based on such data may continue to favour them disproportionately. Kim (2023) cautions that without intentional safeguards, technological innovations risk entrenching privilege rather than expanding opportunity.

Equity concerns have therefore become central in the discussion of gifted identification. Scholars emphasise the importance of culturally responsive frameworks that recognise diverse forms of giftedness, including those rooted in cultural traditions, community leadership, or resilience in the face of adversity (Fugate et al., 2021; Mun et al., 2020). For gifted education to be inclusive, identification methods must account for different ways of knowing and demonstrating ability. This requires moving beyond one-size-fits-all assessments and embracing pluralistic approaches that honour cultural diversity. In light of these issues, this paper explores the continuities and transformations in gifted identification with special attention to the role of technology and equity. It asks: How have traditional markers of giftedness, such as cognitive ability, creativity,

and educator judgment, endured over time? In what ways have new technologies—such as AI, adaptive learning, and psychometric modelling—transformed identification practices? And what equity and ethical challenges accompany these changes? By synthesising recent scholarship, the paper seeks to provide a balanced perspective that recognises both the enduring strengths of traditional approaches and the innovative potential of emerging methods, while emphasising the ethical responsibility to ensure fairness and inclusivity.

Literature Review

Historical Perspectives on Gifted Identification

Understanding the historical development of gifted identification is critical to appreciating the continuities and transformations shaping the field today. Over the past century, definitions of giftedness and the methods used to identify gifted learners have shifted from narrow, IQ-focused approaches toward broader frameworks that incorporate creativity, leadership, and domain-specific talents. This section traces that evolution, beginning with the rise of intelligence testing, moving through the critiques of IQ-based definitions, and culminating in more holistic conceptualisations that emphasise the multidimensional nature of giftedness. The earliest systematic attempts to identify gifted students were heavily influenced by psychometric traditions, particularly the development of intelligence quotient (IQ) tests (Kaufman et al., 2022). Lewis Terman's pioneering longitudinal study of gifted children in the early twentieth century cemented IQ as the dominant marker of giftedness in the United States and beyond (Lubinski, 2016). Giftedness was typically defined as an IQ score above a fixed threshold—often 130 or higher—corresponding to roughly the top 2 per cent of the population (Silverman, 2018). This definition carried the appeal of objectivity and standardisation, offering educators a seemingly scientific method to distinguish between "average" and "exceptional" learners.

While IQ-based definitions provided a foundation for early gifted education programs, they were also deeply limited. First, they reduced giftedness to a single dimension: cognitive performance on standardised measures. This narrow focus neglected other important domains of human ability, such as creativity, social leadership, and artistic expression. Second, IQ tests reflected cultural and linguistic biases. Children from minority and low-income backgrounds often underperformed on these tests, not because of lower ability but because the test content was aligned with middle-class, Western cultural norms (Au, 2022). Finally, the assumption that giftedness was a fixed trait measured once in time ignored developmental variability. Students whose talents emerged later, or who required enriched learning environments to display their potential, were often overlooked. These limitations prompted growing criticism of IQ-centric models.

As Kuznetsova et al. (2024) observe, giftedness has always been a fluid and contested concept, resistant to reduction to a single score. The dissatisfaction with purely psychometric definitions laid the groundwork for more expansive approaches that recognised giftedness as multidimensional and context-dependent.

As definitions of giftedness broadened, identification practices also began to diversify. Alongside standardised tests, schools introduced teacher nominations, portfolio assessments, creativity tests, and performance tasks. While these approaches aimed to capture a fuller picture of student ability, they also introduced new challenges. Teacher nominations, for instance, allowed educators to recognise gifted traits overlooked by tests, but they were also susceptible to bias, often underrepresenting students from marginalised backgrounds (Robertson, 2024). Nonetheless, these shifts reflected a growing consensus that giftedness is multifaceted and dynamic. By the early twenty-first century, many scholars and policymakers acknowledged that relying solely on IQ scores was inadequate. Instead, identification systems increasingly combined multiple measures to balance objectivity with contextual sensitivity. Davis and Willson (2015) describe this hybrid approach as an attempt to integrate formal, test-based measures with informal, observational methods to create a more equitable and comprehensive process. This synthesis underscores the complexity of identifying gifted learners. While IQ remains a central reference point, it is now situated within broader frameworks that emphasise the multidimensional and developmental nature of talent. Historical perspectives thus illuminate both the stability of certain criteria and the necessity of ongoing refinement to ensure that gifted education remains inclusive, fair, and responsive to diverse forms of human ability.

Technological Innovations in Gifted Identification

The past two decades have witnessed a remarkable transformation in how gifted students are identified, largely driven by rapid advancements in educational technology. While traditional approaches emphasised static IQ and standardised tests, technological tools now provide more dynamic, individualised, and multidimensional methods of assessment. Thematic analysis of literature from 2015 to 2025 highlights five major areas of innovation: the use of information and communication technology (ICT), adaptive learning systems, artificial intelligence (AI), psychometric modelling, and neuroscience-informed approaches. Together, these innovations are reshaping gifted identification by broadening what is measured, how data is collected, and how potential is understood.

One of the earliest technological shifts in gifted education has been the integration of ICT tools. Digital classrooms, online discussion platforms, and

mobile learning technologies create environments where gifted learners can showcase abilities that may not emerge in traditional settings. Alamri et al. (2020) argue that ICT fosters personalised learning environments that allow students to pursue their interests at greater depth and at their own pace. For example, online discussion forums provide spaces where gifted students can demonstrate advanced reasoning and critical thinking, even if they are less vocal in physical classrooms. ICT also facilitates collaboration across geographical boundaries. Gifted students often benefit from interaction with intellectual peers, and digital platforms make it possible for them to connect with others worldwide, exchange ideas, and engage in joint problem-solving tasks. Such environments reveal talents in creativity, communication, and leadership that may not be captured by standardised measures. Thus, ICT expands the contexts in which giftedness can be observed and identified.

Building on ICT foundations, adaptive learning systems represent a more sophisticated tool for gifted identification. These systems adjust instructional content in real time, based on learners' performance and behaviour. By continuously calibrating task difficulty, adaptive platforms not only support differentiated learning but also generate detailed data about how students respond to challenges. Demartini et al. (2024) explain that adaptive learning systems powered by AI track students' mastery of concepts and detect patterns of accelerated learning. Gifted students often demonstrate rapid acquisition of knowledge and unusual problem-solving strategies, traits that adaptive systems can highlight with precision. For instance, when a student consistently outpaces the system's benchmarks or demonstrates resilience in tackling increasingly complex tasks, the data serves as evidence of gifted potential. Unlike traditional tests, which provide a one-time snapshot, adaptive systems offer continuous streams of information that reflect a learner's developmental trajectory. This makes identification more dynamic and responsive, reducing the likelihood of overlooking late bloomers or students whose abilities are context-dependent.

Perhaps the most transformative innovation in recent years is the application of AI and machine learning to gifted identification. AI systems analyse both static data (such as test scores) and dynamic data (such as learning behaviours, time spent on tasks, or problem-solving pathways). This allows for nuanced profiling of students' strengths and weaknesses. Ravand and Baghaei (2020) note that diagnostic classification models (DCMs) and knowledge component (KC) modelling, powered by AI, provide educators with predictive insights into students' performance. These models assess mastery of underlying skills and attributes, offering a more fine-grained understanding of giftedness than broad IQ measures. For example, an AI system may detect exceptional mathematical reasoning in a student who performs only moderately well on traditional

assessments, thereby uncovering hidden potential. AI can also reduce human bias by relying on objective performance data. However, as later sections of this review will discuss, this potential is contingent on careful design, as biased datasets may perpetuate inequities (Shah & Sureja, 2025). Still, when thoughtfully implemented, AI provides unprecedented opportunities to identify giftedness across diverse domains, including problem-solving, creativity, and socio-emotional competencies.

Alongside AI, innovations in psychometric modelling have broadened the tools available for assessing giftedness. Traditional psychometrics focused heavily on verbal and quantitative reasoning, but contemporary models seek to capture more complex traits, such as creativity, divergent thinking, and socio-emotional intelligence. Lopez-Gazpio (2021) highlight the use of project-based and game-based assessments, which not only engage students but also generate rich data about their intellectual and creative capacities. Unlike traditional timed tests, these assessments require sustained effort, collaboration, and innovation—qualities often associated with giftedness. Moreover, psychometric models now emphasise domain-specific assessment. Jung (2022) observes that physical giftedness, for instance, requires identification tools distinct from those used for academic talent. Modern psychometrics, therefore, employs tailored methods that respect the unique demands of different fields, from sports science to artistic performance. This flexibility marks a significant departure from the "one test fits all" philosophy of early IQ assessments.

A final area of innovation is the integration of neuroscience into gifted identification. While still emerging, neuroscience offers promising insights into the biological underpinnings of exceptional ability. Advances in brain imaging, for example, make it possible to observe neural activation patterns associated with specific talents, such as spatial reasoning or musical intelligence. Shearer (2020) argues that combining multiple intelligences theory with neuroscience and big data creates opportunities for more individualised assessments. For instance, a student who does not excel in traditional academic domains may nevertheless demonstrate unusual neural activity in areas linked to creativity or sensory-motor coordination. These insights challenge narrow definitions of giftedness and call for more comprehensive identification frameworks. Although neuroscience-based identification is not yet widely implemented, its potential lies in providing objective evidence of abilities that are otherwise difficult to capture. It also emphasises the importance of viewing giftedness as multifaceted, encompassing not only intellectual performance but also biological and cognitive diversity. The value of these tools depends on their thoughtful integration into educational systems, guided by human oversight and equity-driven policies. Without such safeguards, technological innovations may replicate the very biases

they seek to eliminate.

Equity, Ethics, and Inclusivity in Gifted Identification

While technological advancements have expanded the possibilities for identifying gifted students, issues of equity and ethics remain pressing. Historical reliance on IQ tests and standardised measures has already raised concerns about cultural bias and the underrepresentation of minority and disadvantaged groups. The introduction of sophisticated tools such as artificial intelligence (AI), adaptive learning, and big data has not eliminated these challenges; in some cases, it has amplified them. A thematic review of literature from 2015 to 2025 highlights three interrelated concerns: persistent inequities in gifted identification, the ethical risks of algorithmic bias, and the need for culturally responsive and inclusive frameworks.

Equity challenges in gifted education are not new. For decades, scholars have documented the disproportionate exclusion of culturally, linguistically, and economically diverse (CLED) students from gifted programs (Alexander, 2025). This underrepresentation often stems from reliance on standardised measures that reflect the values and experiences of dominant groups. As Barr (2025) argues, deficit-based perceptions held by educators further exacerbate the problem, leading to the systematic overlooking of talented students from marginalised backgrounds. Diamond and Persson (2016) note that teacher nominations—often intended as a corrective to standardised testing—remain vulnerable to bias. Educators may unconsciously privilege traits associated with middle-class norms, thereby overlooking expressions of giftedness in students whose cultural backgrounds differ from their own. This dynamic contributes to the continued exclusion of many capable learners from advanced opportunities. The inequitable distribution of resources compounds these issues. Schools in wealthier areas are more likely to have access to advanced programs, specialised teachers, and enrichment activities that foster gifted potential. In contrast, underfunded schools often lack both the resources and the expertise needed for effective identification. This systemic disparity highlights the importance of addressing equity not only at the level of assessment tools but also through broader policy reforms.

The growing use of AI and machine learning in gifted identification has introduced new ethical concerns. While these technologies promise objectivity, they are ultimately dependent on the quality of the data used to train them. Wiggins and Jones (2023) caution that algorithms can inherit and amplify historical inequities embedded in datasets. For example, if past gifted programs disproportionately admitted students from privileged groups, AI models trained on this data may learn to associate giftedness with those demographics, perpetuating cycles of exclusion. Algorithmic bias manifests in several ways. One

form is biased feature selection, where the variables chosen to indicate giftedness—such as standardised test scores—reflect cultural and socioeconomic privilege. Another is feedback loops: if AI models repeatedly recommend students from advantaged backgrounds for gifted programs, those students gain further opportunities, reinforcing the algorithm's assumptions over time. Such dynamics risk institutionalising inequity under the guise of technological neutrality. Beyond bias, ethical concerns extend to privacy and surveillance. Real-time data collection in adaptive learning platforms, for instance, generates vast amounts of personal information. Without strict safeguards, students' data could be misused or misinterpreted. The ethical imperative, therefore, is not only to refine technical design but also to embed transparent, accountable policies for data governance in educational contexts.

Given these risks, scholars emphasise the necessity of culturally responsive frameworks for gifted identification. Inclusivity requires rethinking both the criteria for giftedness and the processes used to identify it. Shearer (2020) highlights that giftedness often manifests in culturally specific ways, such as oral storytelling traditions, community leadership, or collective problem-solving. Standardised Western models, however, rarely recognise these abilities as markers of high potential. Mun et al. (2020) argue that systemic capacity building is essential for equitable identification. This involves training educators to recognise diverse forms of giftedness, revising policies to support inclusive practices, and ensuring that schools serving marginalised communities have access to appropriate resources. Culturally responsive identification also requires involving families and communities, who are often better positioned than teachers or standardised tests to recognise gifted traits in children. Technology can support inclusivity if applied carefully. Adaptive systems can be programmed to reduce linguistic barriers, for example, by offering assessments in multiple languages or incorporating culturally relevant content. However, inclusivity must be intentional. As Peña Gangadharan and Niklas (2019) observe, without explicit commitment to equity, technological tools risk reflecting dominant cultural values and excluding minority voices.

Despite the promise of advanced technologies, human oversight remains indispensable for equitable gifted identification. Educators, counsellors, and psychologists must interpret data in light of cultural and contextual factors that algorithms cannot fully capture. For example, a student may perform modestly on AI-driven tasks but demonstrate extraordinary leadership within their community. Human judgment is necessary to ensure that such talents are not overlooked. At the same time, human oversight is not without its limitations. Biases in teacher nominations and cultural assumptions about ability continue to skew identification processes. As Mun et al. (2020) emphasise, professional

development in culturally responsive pedagogy is critical if human oversight is to enhance equity rather than perpetuate inequity. The ethical challenge is to balance the efficiency and scale of technological tools with the contextual sensitivity and cultural awareness of human professionals. The synthesis suggests that equitable gifted identification depends on three interlocking strategies: diversifying the criteria used to define giftedness, designing technological systems that actively counteract bias, and equipping educators with the skills and awareness needed for culturally sensitive judgment. Without these safeguards, technological innovation may fail to achieve its potential and instead reinforce cycles of privilege.

METHOD

This research adopted a qualitative desk research approach, relying on a systematic review and synthesis of existing literature on the identification of gifted students. The method involved three main stages: Relevant scholarly publications, policy documents, and empirical studies were sourced from academic databases such as Scopus, Web of Science, ERIC, and Google Scholar. Keywords including gifted identification, technological advancement, AI in education, equity in gifted education, continuities and discontinuities, and algorithmic bias guided the search. Sources published between 2015 and 2024 were prioritised to capture recent developments, though seminal works on historical perspectives were also included. Articles were included if they addressed: Historical and contemporary methods of identifying gifted students, the impact of technology (ICT, AI, adaptive learning, psychometric models, neuroscience), or Issues of equity, inclusivity, and ethical concerns in gifted identification. A thematic analysis was conducted to identify continuities and transformations in gifted identification. Selected studies were coded according to recurring themes: (i) traditional IQ-based and standardised approaches, (ii) technological innovations, (iii) challenges of algorithmic bias and systemic inequities, and (iv) strategies for equity and inclusivity. The synthesis compared past and present practices to highlight both enduring elements and transformative shifts in the field. Through this method, the paper offers an integrative perspective that bridges historical foundations with contemporary innovations, while critically examining the role of technology and equity in shaping the future of gifted education.

RESULT AND DISCUSSION

Result

This research set out to examine continuities and transformations in the identification of gifted students, with particular attention to the role of technology and equity. Through a thematic review of literature published

between 2015 and 2025, several patterns emerged.

Continuities in Gifted Identification

Although the field of gifted education has seen significant innovation in recent years, certain core principles remain remarkably stable. The reliance on educators' professional judgment remains a constant feature of the field, even as debates over bias and equity persist. One of the most consistent features of gifted education is the emphasis on cognitive ability. From early IQ testing traditions to contemporary multifaceted models, intellectual capacity continues to play a central role in determining who qualifies as gifted. Scholars argue that while the definition of giftedness has broadened, cognitive performance remains the foundation upon which other indicators are built (Dai, 2020; Renzulli, 2021). Desvaux et al. (2024) found that children identified as gifted typically exhibit advanced reasoning skills, rapid information processing, and the ability to apply knowledge flexibly. Such capacities allow them to excel academically and adapt effectively to new and complex learning tasks. Similarly, Sezgin and Ulus (2020) demonstrated that preschool-aged children identified as gifted display cognitive flexibility and metacognitive awareness earlier than their peers, enabling them to grasp abstract concepts that most children of their age group struggle with. This enduring reliance on cognitive ability is partly practical. Schools and educational systems seek measurable criteria that can reliably distinguish high-potential learners. IQ scores, aptitude tests, and cognitive assessments provide quantifiable benchmarks that are relatively easy to administer and compare. Despite criticism that such tools oversimplify human ability, their continued use reflects a deep-rooted belief that intellectual performance remains a meaningful indicator of gifted potential.

In addition to general intelligence, problem-solving ability has long been associated with giftedness. Gifted learners consistently demonstrate an ability to analyse complex issues, generate solutions, and transfer insights across domains. According to Barak and Levenberg (2016), these traits distinguish them from their peers, particularly in contexts requiring flexible thinking and innovation. Problem-solving also links to the broader goals of education. Gifted students are often seen as future innovators, leaders, and contributors to societal progress. Their capacity to approach problems creatively and persistently is therefore valued not only for academic achievement but also for its potential social and economic impact (Gajda et al., 2017). This view reinforces the continuity of problem-solving as a criterion for identification across generations of gifted education research and practice. Creativity has also endured as a key dimension of giftedness, even as definitions of the construct have expanded. Rooted in the work of scholars such as Guilford and Torrance, creativity has been consistently linked to divergent thinking, originality, and the ability to generate multiple

solutions to open-ended problems. Shearer (2020) underscores that creativity remains a defining trait of gifted individuals, especially in domains such as the arts, design, and scientific discovery.

Wang et al. (2019) similarly observed that gifted children often express creativity through imaginative play, artistic expression, or innovative approaches to academic tasks. These tendencies are not confined to traditional "creative" subjects but extend to mathematics, science, and problem-solving more broadly. For this reason, creativity is consistently included alongside intelligence and task commitment in influential models such as Renzulli's three-ring conception of giftedness. Despite ongoing debates about how best to measure creativity, its recognition as a marker of giftedness has persisted. Creative ability continues to be incorporated into formal identification processes through creativity tests, portfolio assessments, and classroom observations. This continuity reflects a recognition that intelligence alone is insufficient to capture the full scope of human potential. Another striking continuity in gifted identification is the reliance on educators' professional judgment. Teachers, counsellors, and parents often serve as the first to recognise exceptional ability, nominating students for further assessment or placement in gifted programs. Ateş and Afat (2018) point out that observational methods allow educators to capture early signs of giftedness, such as precocious language development, strong memory, or intense motivation, which may not always be reflected in standardised test results.

This reliance on human judgment has practical advantages. Teachers interact with students daily and can observe patterns of behaviour, motivation, and performance across varied contexts. They are therefore positioned to identify subtle forms of giftedness that might otherwise be overlooked. However, this continuity is not without challenges. Mun et al. (2020) note that teacher nominations often reflect personal biases, cultural assumptions, or deficit perspectives. For example, students from culturally, linguistically, and economically diverse (CLED) backgrounds are frequently underrepresented in gifted programs because educators may misinterpret differences in communication or behaviour as a lack of ability. Despite these limitations, teacher judgment continues to play a central role in identification processes around the world. This persistence highlights both the enduring trust placed in professional insight and the ongoing need for training and awareness to reduce bias and promote equitable practices. Taken together, these findings show that cognitive ability, problem-solving, creativity, and teacher judgment remain central to gifted identification despite the proliferation of new tools and approaches. Their endurance reflects both tradition and practicality: schools seek reliable, observable, and measurable indicators, and these four criteria have

consistently proven valuable across contexts. These tensions suggest that while continuities provide stability and comparability over time, they must be continually refined to reflect evolving understandings of human potential.

Transformations in Gifted Identification

The field of gifted education has undergone a significant transformation in recent decades. While cognitive ability and creativity continue to serve as markers of exceptional potential, the approaches used to identify such abilities are shifting away from static, one-time evaluations toward more dynamic, technology-driven methods. A thematic analysis of recent literature (2015–2025) highlights three main areas of transformation: the move from fixed IQ testing to dynamic assessment, the adoption of real-time evaluation supported by artificial intelligence (AI) and adaptive learning systems, and the growing reliance on advanced psychometric and neuroscientific models. Traditional identification of giftedness has long been dominated by IQ tests and standardised academic measures. While these instruments provided a sense of objectivity, they have been criticised for oversimplifying the complex construct of giftedness and for overlooking diverse expressions of talent (Cross & Olszewski-Kubilius, 2021). One of the most notable transformations, therefore, is the shift toward dynamic, process-oriented approaches that move beyond static testing. Dynamic assessment integrates evaluation into the learning process rather than separating it from instruction. For example, Shanta (2022) explains that embedding assessments into classroom activities allows teachers to observe not only what students know but also how they learn, adapt, and problem-solve in real time. This model recognises giftedness as a developmental phenomenon rather than a fixed trait, emphasising growth, resilience, and socio-emotional capacities such as motivation and collaboration.

In practical terms, dynamic assessment enables educators to identify students whose potential may not be immediately apparent through IQ scores alone. A child who demonstrates persistence in solving a complex task or shows creativity in approaching a science experiment, for instance, may be identified as gifted even if their standardised test results are average. By broadening the lens of identification, dynamic assessment reflects a more inclusive and realistic understanding of human potential (Stringer, 2018). Building on dynamic principles, real-time evaluation represents another major transformation in gifted identification. Unlike traditional assessments, which provide a snapshot of ability at one point in time, real-time methods continuously monitor a student's learning trajectory. Adaptive learning systems, powered by AI, track individual performance patterns, offering educators insight into how quickly and effectively students master new content. Okonji and Igwe (2025) emphasise that AI-driven adaptive platforms personalise instruction by adjusting task difficulty according

to each learner's progress. These systems not only identify students who consistently outperform peers but also reveal hidden strengths in areas such as critical thinking or creative problem-solving. For gifted identification, this creates a richer and more nuanced profile of student ability than any single test score could provide.

Furthermore, real-time evaluation reduces the likelihood of misidentification by capturing a student's performance across multiple contexts and over extended periods. For example, a student who performs poorly on a standardised test due to anxiety may nevertheless excel in adaptive online tasks that adjust to their comfort level. As a result, real-time data offers a fairer and more reliable means of spotting gifted potential (Shen et al., 2023). Another important transformation involves the integration of AI and advanced psychometric models in assessment design. Traditional psychometric tests measured primarily cognitive and verbal skills, but new models expand this scope to include creativity, socio-emotional intelligence, and domain-specific talents. AI technologies make it possible to analyse both static data (e.g., test results) and dynamic data (e.g., patterns of problem-solving over time), thus producing more accurate predictions of student potential (Ouyang et al., 2023). Diagnostic classification models (DCMs) and knowledge component (KC) modelling, for instance, allow educators to map how students acquire complex skills and where they demonstrate exceptional mastery. Such approaches make it easier to identify non-linear learning patterns that may signal giftedness in specific domains, such as mathematics, music, or coding. By leveraging these models, assessments move beyond the one-size-fits-all framework of IQ tests to capture the multidimensional nature of giftedness.

Neuroscience has also entered the conversation, with scholars such as Shearer (2020) advocating for the integration of brain imaging and neural activation studies into assessment practices. These tools offer insight into cognitive processes like spatial reasoning or musical aptitude, which may not be visible through conventional testing. While still developing, the use of neuroscience promises a more comprehensive and individualised approach to gifted identification. While technological advancements offer powerful new tools, they also bring ethical challenges. One of the most pressing concerns is algorithmic bias. Mergen et al. (2025) caution that AI systems trained on biased datasets may inadvertently reinforce existing inequalities. For example, if previous gifted programs underrepresented culturally and linguistically diverse (CLED) students, AI models based on that data may continue to prioritise indicators associated with privileged groups. Equity concerns extend beyond AI. Mun et al. (2020) argue that systemic capacity building is essential for ensuring that new identification models do not exclude marginalised populations.

Without intentional efforts—such as training teachers in culturally responsive practices, developing inclusive policies, and involving communities—technological innovations may exacerbate disparities rather than resolve them. These challenges highlight the importance of human oversight. While AI and psychometric models can provide valuable insights, educators must ultimately interpret the data, contextualise findings, and make decisions that account for cultural and individual differences. The transformation of gifted identification, therefore, is not merely technical but ethical, demanding a commitment to fairness alongside innovation. The future of gifted identification depends on striking a balance: embracing technological innovations while ensuring that equity, human judgment, and ethical considerations remain at the forefront.

Equity and Ethical Concerns in Gifted Identification

As identification practices evolve from static IQ-based testing toward dynamic, technology-driven approaches, questions of equity and ethics have become increasingly central. The promise of artificial intelligence (AI), adaptive learning, and big data is tempered by the risk that these innovations may reinforce the very inequities they aim to overcome. A thematic analysis of studies published between 2015 and 2025 reveals three recurring challenges: algorithmic bias and systemic inequities, the need for culturally responsive and inclusive identification practices, and the continuing importance of human oversight. One of the most pressing ethical concerns in technologically mediated gifted identification is the problem of algorithmic bias. AI-driven models are only as unbiased as the datasets on which they are trained. When historical data reflects patterns of underrepresentation—such as the exclusion of students from culturally, linguistically, and economically diverse (CLED) backgrounds—algorithms risk perpetuating those same inequities. Lockwood and Brown (2025) warn that if AI systems learn from data embedded with systemic disparities, they may produce outputs that disproportionately privilege students from dominant social groups.

For instance, standardised test results have historically been weighted heavily in gifted identification processes. Yet access to test preparation resources often correlates with socioeconomic status. If AI models are trained on such datasets, they may inadvertently signal that high performance is more likely among students from wealthier, resource-rich backgrounds. This produces a feedback loop: privileged groups continue to be overrepresented in gifted programs, while marginalised groups remain excluded. Systemic inequities extend beyond algorithms. Mun et al. (2020) argue that inequitable school structures and deficit-based perceptions among educators have long hindered access for CLED students. Without targeted interventions, the introduction of sophisticated technologies may amplify these inequities rather than resolve

them. The ethical concern, therefore, is not only about the technology itself but also about the broader social systems into which it is embedded. Equity in gifted identification requires more than technical fixes; it demands a reconceptualisation of what counts as giftedness and how it is measured. Scholars highlight that traditional definitions often privilege cognitive and linguistic skills aligned with Western academic norms, while undervaluing other forms of ability. This narrow view marginalises students whose talents manifest in non-traditional ways, such as artistic expression, community leadership, or resilience in challenging environments (Shearer, 2020).

Inclusive identification practices must therefore embrace cultural diversity and recognise multiple pathways to giftedness. Culturally responsive frameworks expand assessment criteria to include strengths that may not appear on standardised tests but are equally valuable indicators of potential. For example, students from collectivist cultures may demonstrate giftedness through collaboration and social leadership, while others may reveal talent through oral traditions or creative storytelling. These capacities, though often overlooked, represent critical dimensions of human intelligence that must be incorporated into equitable identification models (Mun et al., 2020). Technology can assist in this process if designed responsibly. Adaptive learning platforms, for instance, can tailor assessments to students' cultural and linguistic backgrounds, reducing the reliance on one-size-fits-all instruments. However, inclusivity must be embedded intentionally in system design. Without deliberate efforts to diversify datasets and expand criteria, AI risks reinforcing the same cultural biases as traditional methods.

Despite advances in AI and psychometric modelling, human oversight remains essential in ensuring fairness and ethical integrity in gifted identification. Automated systems may be efficient in analysing large datasets, but they cannot fully account for contextual nuances, cultural factors, or socio-emotional dynamics that shape students' experiences. As Ludolph and Schulz (2018) emphasise, technical debiasing methods are insufficient without critical human intervention. Teachers, counsellors, and psychologists play a crucial role in interpreting data and making holistic judgments. For example, an AI system may flag a student as "average" based on standardised metrics, but a teacher who observes the child's advanced reasoning in class discussions may recognise hidden potential. Human judgment can thus serve as a corrective to algorithmic limitations, ensuring that giftedness is identified in all its diverse forms. At the same time, human oversight is not immune to bias. Educators themselves must receive training in culturally responsive practices to minimise deficit thinking and broaden their conception of giftedness. As Lisle-Johnson and Kohli (2020) note, teacher nominations often reflect cultural assumptions and may

underrepresent students from marginalised groups unless accompanied by professional development and policy support. Thus, ethical identification requires a partnership: technology provides tools for efficiency and scale, while human oversight ensures equity, context, and inclusivity.

Equity in gifted identification extends beyond the classroom to the level of educational policy and systemic reform. Mun et al. (2020) argue that inequitable access to gifted programs reflects deep-seated structural issues, including resource disparities, leadership practices, and district-level policies. Ethical responsibility lies not only with individual educators but also with policymakers who shape the frameworks within which identification occurs. Developing equitable policies requires intentional action. This includes diversifying assessment tools, ensuring equal access to advanced learning opportunities, and engaging parents and communities in the identification process. Policies must also allocate resources to schools serving disadvantaged populations, ensuring that gifted education does not remain a privilege of the few. Ethical practice, in this sense, involves dismantling systemic barriers rather than merely reforming assessment techniques. The thematic synthesis of recent literature suggests that equity and ethics are not peripheral concerns but central to the transformation of gifted identification. Algorithmic bias and systemic inequities threaten to undermine the promise of technological innovation, while culturally responsive approaches and human oversight provide pathways toward inclusivity. The future of gifted identification depends on integrating innovation with ethical responsibility, ensuring that all students—regardless of background—have the opportunity to be recognised and nurtured.

Discussion

The results of this research present a complex but revealing picture of how gifted identification has both held onto long-standing traditions and embraced new technological possibilities. At the most basic level, the findings confirm what has been observed for decades: giftedness continues to be defined primarily in relation to cognitive ability, creativity, problem-solving capacity, and the judgments of educators. These markers have proven durable not only because they are widely recognised and measurable, but also because they offer practical ways of distinguishing exceptional learners within the constraints of schools and educational systems. Yet, alongside this continuity, the research also highlights a profound transformation—driven largely by advances in artificial intelligence, adaptive learning, and psychometric innovation—that is reshaping how educators and policymakers think about, and attempt to capture, gifted potential. This duality—the persistence of the old and the promise of the new—creates an important point of comparison with other scholarship in the field. Similar to

Warne's (2019) critique of IQ-centric gifted education, this research reinforces concerns that static measures like intelligence tests often oversimplify human capacity and marginalise students from culturally diverse or economically disadvantaged backgrounds. However, in contrast to earlier critiques that called primarily for the abandonment of IQ-based identification, the present findings suggest a more balanced position: cognitive measures still play a role, but they must now be interpreted within a larger, multidimensional framework. This resonates with Cross and Olszewski-Kubilius (2021), who argue that giftedness is better understood as a constellation of abilities expressed differently across contexts. The findings also align with contemporary enthusiasm for AI and adaptive learning systems (Demartini et al., 2024), but they diverge from overly optimistic accounts by underscoring that without deliberate safeguards, these tools risk reinforcing the very inequities they are meant to dismantle (Lockwood & Brown, 2025). Reflecting on these results within a broader societal frame, one can see that gifted identification mirrors the larger dilemmas of the digital age. Across sectors, from employment to healthcare, AI has been heralded as a solution to problems of inefficiency, bias, and under-detection of talent. Yet the same technologies have also been criticised for reproducing privilege and creating new forms of exclusion. Education is no exception. The struggle to fairly identify gifted learners thus becomes a microcosm of a wider human challenge: how to harness technological innovation without sacrificing equity and inclusivity. The research findings suggest that progress in gifted education will only be sustainable if equity is treated as central rather than peripheral. The question is not simply how to measure giftedness more accurately, but whose giftedness is being recognised and whose is being overlooked.

The implications of these findings are significant for practice and policy. On a practical level, schools need to rethink the heavy reliance on single-point assessments and expand identification processes to include ongoing, dynamic evidence of student growth. Adaptive platforms and AI tools offer opportunities to capture developmental trajectories, but they must be implemented responsibly, with attention to diverse cultural and linguistic backgrounds. At the policy level, equity concerns require systemic responses: investment in teacher training, equitable distribution of resources, and stronger partnerships with communities to ensure that definitions of giftedness reflect multiple ways of knowing and learning. Unless these structural issues are addressed, the introduction of new technologies may only reproduce old patterns of exclusion under a more modern guise. The persistence of traditional markers in gifted identification can be explained by their deep institutional embeddedness and the convenience they offer to school systems that require clear benchmarks. At the same time, the growing embrace of technology reflects global educational trends

that favour personalisation, efficiency, and data-driven decision-making. The ethical tensions identified—particularly around algorithmic bias—stem from the fact that innovations are being deployed in systems already marked by inequality. In this sense, the research results are less an anomaly than a reflection of broader educational realities in which structural inequities and technological aspirations collide.

Looking ahead, the findings call for a reformulation of identification practices that blends innovation with responsibility. Several concrete actions are necessary. First, AI and adaptive learning systems should be developed and tested with culturally diverse datasets to minimise algorithmic bias. Second, the criteria for giftedness must be broadened to include socio-emotional strengths, resilience, and culturally specific forms of ability that go beyond conventional academic benchmarks. Third, educators should receive sustained professional development in culturally responsive pedagogy to ensure that human judgment complements, rather than undermines, technological tools. Finally, gifted education must be grounded in policy reforms that guarantee equitable access to enrichment opportunities, particularly for schools in under-resourced communities. In sum, the research reveals both the resilience of traditional approaches and the disruptive potential of technological innovations in gifted identification. The challenge—and the opportunity—lies in negotiating this intersection in ways that avoid replicating inequities. By situating technological advances within frameworks of equity and cultural responsiveness, the identification of gifted learners can move closer to fulfilling its promise: not only recognising exceptional potential but ensuring that such recognition is distributed fairly across all segments of society.

CONCLUSION

This research has shown that while many of the traditional pillars of gifted identification—such as cognitive ability, problem-solving, creativity, and teacher judgment—remain intact, the way these criteria are now being approached is undergoing a significant shift. What stands out from other research is the recognition that technology is not simply an additional tool layered onto existing practices, but a force that actively reshapes the very meaning of identification. Previous scholarship has often either celebrated artificial intelligence and adaptive learning as revolutionary solutions or dismissed them as reproducing old biases in new forms. The present research takes a different position: it demonstrates that the value of these tools lies in how they are embedded within systems of equity and cultural responsiveness. In other words, technology is not inherently liberating or exclusionary—it is the context and intention of its use that determines its impact. The most important finding that departs from earlier

research is the dual recognition that continuity and transformation coexist in the identification of gifted learners. While many past studies framed the debate as an either/or—either traditional IQ-based models or innovative AI-driven systems—this research reveals that both strands continue to operate side by side, often in tension. This nuanced understanding broadens the conversation beyond dichotomies and allows for a more realistic picture of how schools are actually negotiating change.

In terms of contribution, the research offers both conceptual and methodological value. Conceptually, it reframes gifted identification as a dynamic process that must be situated within questions of cultural equity, rather than as a static exercise in measuring ability. By emphasising the interplay of tradition, innovation, and ethics, the research provides a framework that can guide policymakers and educators in balancing stability with responsiveness. Methodologically, the research demonstrates the usefulness of a thematic synthesis that bridges historical and contemporary literature. This approach not only traces continuities and shifts across time but also uncovers the ethical dilemmas that accompany technological adoption, offering a richer perspective than studies that focus narrowly on either traditional or modern approaches. The contribution of this research lies in its insistence that gifted education must be about more than identifying the brightest few. It must also be about how societies choose to recognise, nurture, and distribute opportunity fairly. In this sense, the findings extend beyond the immediate field of gifted education to touch on larger questions of justice, inclusion, and the role of technology in shaping human potential.

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