

An Examination of Mathematics Teachers' Views on Differentiated and Individualized Education Programs for Gifted Students Developed with Artificial Intelligence

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Received : 10.11.2025

Accepted : 13.01.2026

Doi: <https://doi.org/10.17522/balikesirnef.1821050>

Abstract - The rapid development of artificial intelligence (AI) technologies in the field of education offers new opportunities in personalized learning and instructional design. The purpose of this study is to examine the effectiveness of three different AI tools (ChatGPT, Gemini, and DeepSeek) in preparing an differentiated and individualized education programs (DIEP) that can be used in the education of gifted students, based on teachers' opinions. The research employed a basic qualitative research design; the participant group consisted of six middle school mathematics teachers working at Science and Art Centers in Türkiye. Data were collected using a semi-structured interview form developed by the researchers; teachers were asked to rate each AI tool on a 1–5 Likert scale according to specified criteria and to explain their opinions. The findings indicate that ChatGPT was found to be stronger than other tools in terms of content and academic depth, originality and creativity, suitability to students' interests and needs, differentiation and individualization, ease of implementation, and educational and technological consistency. Gemini was found to be pedagogically balanced, while DeepSeek was considered innovative in its interdisciplinary approach but conceptually superficial. In conclusion, the findings indicate that AI tools, when used with teacher guidance, have the potential to offer individualized and deepened learning experiences in the education of gifted students.

Keywords: Artificial intelligence, gifted education, differentiated education program, BİLSEM, mathematics education.

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Introduction

Differentiated and individualized education programs (DIEP) are at the heart of the contemporary "individual development" approach, which aims to transform the potential of gifted students into sustained performance, products, and lasting expertise. The literature emphasizes that giftedness is not a static "essence"; rather, it is a dynamic developmental process shaped by domain-specific demands, opportunity structures, and psychosocial factors and individual differences/preferences (Subotnik et al., 2011). Therefore, content is recognized as critical for differentiated environments that provide opportunities for deepening, original problem solving, production, and mentoring (Reis & Renzulli, 2010).

As a process component of differentiated curriculum, grouping practices remain limited in meeting students' needs when compared to differentiation and acceleration. (Steenbergen-Hu et al., 2016). This can be explained not only by the cognitive gains associated with enrichment (achievement, conceptual understanding, etc.), but also by its role in strengthening interest and talent alignment, thereby fostering persistence, self-efficacy, and innovation orientation.

At the policy level, approaches that view talent development as a long-term "learning ecosystem" point to the necessity of differentiated practices that sustain high-level learning opportunities through early identification (Subotnik et al., 2011). It suggests that these ecosystems should be designed to be accessible and multi-channel (e.g., in-class units, project-based learning, mentoring, competition and research infrastructures) not only for selected groups but for the school as a whole (Reis & Renzulli, 2010).

DIEP is not a "niche" addition to gifted education; it is an evidence-based core strategy that develops talents into meaningful products, while simultaneously nurturing field-specific expertise and 21st-century skills (critical thinking, creativity, collaboration). Within differentiated education theories (e.g., Tomlinson's Differentiated Instruction Model, Gardner's Multiple Intelligences Theory, Vygotsky's Zone of Proximal Development, Bloom's Mastery Learning, and Universal Design for Learning), when well designed and implemented in gifted education contexts, instructional practices have been shown to significantly enhance students' academic achievement, motivation, and productivity (Renzulli & Reis, 2014; VanTassel-Baska & Stambaugh, 2006).

"We might hope that machines and humans will eventually be able to compete in all purely intellectual fields. But where should we begin? That is a difficult question. Many

people believe that a highly abstract activity such as chess would be the most appropriate starting point. Others argue that the better approach is to equip machines with advanced sensory systems and then teach them English.” (Turing, 1950, p.460). Turing’s prediction, made roughly 70 years ago about the trajectory of AI development, has been confirmed by the way AI tools are being created today. Since 2023 in particular, AI has become increasingly integrated into our daily lives and has driven significant transformations across many sectors, including education. The literature indicates that the number of graduate theses and research studies addressing the relationship between AI and education has fluctuated over time. Postgraduate work focusing on social studies education and AI, which first emerged in the early 2000s, expanded considerably throughout the 2020s and reached its peak in 2023. (Yeşilyurt et al., 2024).

AI technologies, which attract attention with their functions such as personalizing learning processes, monitoring student performance, supporting teachers, and providing effective feedback (Kamalov et al., 2023; Luckin et al., 2016), are reshaping the roles of teachers. Especially in the age of digital literacy, teachers' competence in using these technologies for educational purposes directly affects the quality of education. However, the role of AI in education is not limited to its integration into the teaching process; it also has innovative potential in areas such as the preparation of teaching materials, content production, and instructional design (Mollick & Mollick, 2023). AI tools have become effective partners for teachers in both instruction and content creation because they help create effective lesson plans and support classroom applications. This can help teachers use AI more consciously and effectively in classroom applications. For example, previous research has demonstrated that artificial intelligence-based educational programs positively influence multiple components of learning beyond academic achievement. Studies have shown that AI-supported learning environments contribute not only to improved academic performance but also to enhanced student motivation, learning attitudes, and self-regulated learning skills through adaptive feedback and personalized instructional pathways (e.g., Alomari & Jabr, 2020). These findings suggest that AI-based educational programs function as multifaceted differentiation tools that support cognitive, affective, and metacognitive dimensions of learning, particularly in mathematics education contexts.

Within the scope of the literature, the aim of this study is to comparatively evaluate the adequacy of different AI tools in preparing differentiated and individualized education programs (DIEPs) for the education of gifted students, based on teachers’ opinions. In this

respect, the study seeks to provide original data on how AI-supported instructional design can be positioned within gifted education and on the development of emerging models grounded in teacher–AI collaboration. Although the use of artificial intelligence in education has gained increasing attention, existing research remains limited in several important respects, particularly regarding its application in gifted education contexts. The current literature is largely focused on general education settings, student achievement outcomes, or specific intelligent tutoring systems, while empirical studies examining teachers' perspectives on the use of AI tools for differentiated instructional design in gifted education are still scarce. Accordingly, this study contributes to the literature by addressing these gaps and offering concrete insights into how innovative AI-based technologies can support differentiated educational practices for gifted learners. Moreover, the findings are expected to serve as a practical guide for teachers in understanding, evaluating, and effectively integrating AI tools into their instructional planning processes.

In this context, the research examines the adequacy of different AI tools (ChatGPT, Gemini, and DeepSeek) in preparing DIEPs that can be used in the education of gifted students, based on teachers' opinions. Within the scope of the research, the DIEP content generated by each AI tool was evaluated in terms of depth, originality, pedagogical consistency, level of differentiation and individualization, applicability, and technology integration. These evaluation factors were derived from the core principles and structural components of differentiated education programs and gifted education literature, which emphasize depth and complexity of content, enrichment and originality, pedagogical coherence, responsiveness to individual learning profiles, classroom applicability, and meaningful integration of technology. Accordingly, teachers were asked to evaluate the AI-generated DIEPs through these literature-based and pedagogically grounded criteria.

The research problem of this study is to evaluate the DIEPs prepared by ChatGPT, Gemini, and DeepSeek AI tools for gifted students based on the opinions of Science and Art Center (Bilim ve Sanat Merkezleri, BİLSEM) teachers.

The sub-problems of the study are defined as follows:

1-How do teachers evaluate the content quality and academic depth of the DIEPs prepared by ChatGPT, Gemini, and DeepSeek?

2-How do teachers evaluate the originality and creativity of the DIEPs prepared by ChatGPT, Gemini, and DeepSeek?

3- How do teachers evaluate the suitability of DIEPs prepared by ChatGPT, Gemini, and DeepSeek in terms of interest, needs, and abilities?

4-How do teachers evaluate the differentiation and individualization provided in the DIEPs prepared by ChatGPT, Gemini, and DeepSeek?

5- How do teachers evaluate the ease of implementation and overall effectiveness of DIEPs prepared by ChatGPT, Gemini, and DeepSeek?

6- How do teachers evaluate the pedagogical consistency and technological adequacy of DIEPs prepared by ChatGPT, Gemini, and DeepSeek?

Method

Research Design

This study adopted a qualitatively driven embedded mixed-methods research design (QUAL + quan). Although the primary focus of the research was to explore teachers' experiences, perceptions, and interpretations regarding the use of artificial intelligence (AI) tools in preparing DIEPs for gifted students, descriptive quantitative data were embedded in the design to support and enrich the qualitative findings.

The qualitative component of the study was grounded in a basic qualitative research approach, which aims to reveal participants' experiences and meanings related to a specific phenomenon in depth (Merriam, 2013). Within this framework, DIEPs generated by three different AI tools (ChatGPT, Gemini, and DeepSeek) were examined based on teachers' views regarding content quality, pedagogical consistency, originality, differentiation, individualization, applicability, and technological suitability.

In addition to qualitative data, teachers were asked to rate each AI tool using a 5-point Likert scale (1 = very inadequate, 5 = very adequate) across these dimensions. These ratings provided descriptive quantitative data that enabled comparative evaluation of the AI tools and supported the interpretation of qualitative findings.

The quantitative scores were not analyzed independently but were interpreted in conjunction with qualitative data within a holistic descriptive and thematic analysis process. In this way, the embedded mixed-methods design allowed quantitative findings to strengthen, contextualize, and triangulate the qualitative insights derived from teachers' perspectives.

Research Group

In Türkiye, BİLSEM are special educational institutions affiliated with the Ministry of National Education, established to identify and nurture the potential of gifted and talented students. These centers provide supplementary education that students attend outside their regular school hours, offering opportunities to further develop their individual abilities. The primary goal of BİLSEM programs is to foster students' creativity, problem-solving, critical thinking, research, and project development skills. Education in these centers follows a structured program that includes stages such as *identification, support education, talent recognition, talent development, project production, and presentation*. The curriculum is differentiated and interdisciplinary, designed in accordance with students' interests and areas of ability, and is grounded in inquiry-based learning approaches. In this respect, BİLSEM centers are regarded as unique learning environments that enable gifted and talented individuals to realize their full potential. The study group consisted of six middle school mathematics teachers working in different BİLSEMs in the Marmara, Aegean, Southeastern Anatolia, and Mediterranean regions of Türkiye. Three of the participants had master's degrees, and three had doctoral degrees. Criteria sampling, one of the purposive sampling methods, was used to determine the participants.

The criteria for the teachers were:

1. They are employed within the Ministry of National Education's BİLSEM,
2. Have at least 5 years of experience working with gifted students,
3. Have at least 10 years of professional experience in middle school mathematics education.

Data Collection Tools

Data was collected using a student identification form, a semi-structured interview form, and a Likert-type AI scoring form developed by the researchers. The identification form, which aims to identify the student's individual characteristics and get to know the student, was created and finalized with the evaluation of a field expert.

The interview form included 6 open-ended and 7 graded questions aimed at evaluating DIEPs in various dimensions. The questions are included in the findings section. The open-ended questions asked teachers:

1. Content and academic depth,
2. Originality and creativity,
3. Appropriateness to student interests and needs,
4. Differentiation and individualization,
5. Ease of implementation,
6. Educational and technological consistency,

has been prepared to determine their views on these themes. The final version of the open-ended questions was determined by obtaining the opinion of a subject matter expert on whether they reflect the relevant theme.

In addition to the open-ended questions, a rating scale was provided so that teachers could systematically evaluate each AI tool (ChatGPT, Gemini, and DeepSeek). In this scale, participants were asked to rate each AI tool on a Likert scale from 1 to 5 (1 = very inadequate, 5 = very adequate) in the following seven dimensions:

1. Content depth and scientific accuracy
2. Suitability for student level
3. Level of differentiation and personalization
4. Originality and creativity
5. Practicality (from the teacher's perspective)
6. Pedagogical consistency
7. Technological competence (digital content, resource use, etc.)

Thanks to the Likert-type AI scoring form, qualitative data were supported by taking numerical averages for each AI tool in quantitative assessments; both the numerical trends and explanatory comments of teachers were analyzed holistically.

Data Collection

During the research process, a prompt entering study was first conducted for the preparation of the DIEP. The prompt was prepared in English based on the individual characteristics of an 8th grade BİLSEM student who is in talent development level, taking into account a teacher working at BİLSEM who was not involved in the study but met the sample criteria. Based on the characteristics of the student's identification form filled out by

the teacher, prompt entries were tested on the topic of geometry within the scope of middle school mathematics. To prevent AI tools from being influenced by previous user memory interactions, a new session (account) was opened each time. The results obtained from the prompt trials were evaluated by a subject matter expert, and the text part of the prompt was finally created.

AI Prompt Used in the Study

You are a mathematics teacher experienced in working with gifted students. Your task is to design a DIEP in the field of mathematics for a gifted learner.

Prior to the instructional design process, you will be provided with a structured form containing detailed information about the student's characteristics, including learning readiness, interests, learning profile, and cognitive strengths. Based on the information presented in this form, you are expected to prepare a comprehensive and detailed differentiated education program tailored to the specific needs of the gifted student.

While developing the differentiated education program, you should explicitly state the theoretical framework(s) informing your instructional decisions (e.g., differentiated instruction, enrichment-based models, or other relevant approaches) and provide appropriate academic references supporting these frameworks.

The prompt prepared by the researchers was directed in English to three different AI tools (ChatGPT, Gemini, DeepSeek). Responses were received in English from the AI tools on April 15, 2025. The main reason for using English was that AI tools produce more successful results in English. The obtained DIEPs were translated into Turkish using the DeepL AI translation tool in a way that preserved their meaning and were presented to teachers along with the student identification form. DeepL was used to ensure that teachers who needed it within the scope of the article could obtain similar results themselves in the future without needing English proficiency. The DIEP creation part of the research was completed with three different DIEPs obtained from AI tools. The six teachers participating in the research examined the three different DIEPs in detail and responded to the questions and ratings on the interview form. The teachers were coded as T1- T6. The qualitative data were analyzed using a thematic analysis approach, guided by a predefined analytical framework grounded in the differentiated education and gifted education literature. This framework specified the core dimensions through which the quality of differentiated education programs is commonly evaluated, ensuring theoretical alignment and analytical rigor.

All qualitative responses were independently reviewed by three researchers. For each open-ended question, initial codes were generated based on teachers' written responses. Coding was conducted across responses from all participating teachers (six teachers in total) for each AI tool and question. The coding process was primarily deductive, as the thematic framework was established in advance based on literature-supported dimensions of differentiated education programs; however, teachers' responses were carefully examined to ensure that the assigned codes accurately reflected the expressed meanings.

Following the coding process, codes were organized into themes corresponding to the predefined DIEP evaluation dimensions. The quantitative Likert-scale scores associated with each dimension were used to support and contextualize the qualitative interpretations, allowing for a more comprehensive understanding of teachers' evaluations.

Inter-coder agreement was achieved through discussion-based consensus, resulting in a coder agreement rate of 93%. Discrepancies were resolved through collective deliberation until full agreement was reached, thereby strengthening the reliability of the coding process.

Several strategies were employed to enhance the trustworthiness of the study. Researcher triangulation was achieved through the involvement of three independent researchers in the coding and analysis process. Method triangulation was ensured by integrating qualitative data (open-ended teacher responses) with descriptive quantitative data (Likert-scale ratings), consistent with an embedded mixed-methods design. This triangulated approach allowed different types of data to complement and corroborate one another.

Credibility was supported through systematic coding procedures, consensus-based analysis, and the alignment of evaluation criteria with established literature on differentiated education programs. Dependability and confirmability were enhanced by maintaining a transparent analytical process and grounding all themes in both participant data and theoretical frameworks. Together, these methodological strategies contributed to a coherent and robust interpretation of teachers' evaluations of AI-generated differentiated education programs.

Ethical committee approvals were obtained for the research, participants' identity information was kept confidential, and the data were used solely for scientific purposes.

Findings and Discussions

The research findings are presented below within the scope of open-ended questions and sub- problems of the research.

Theme 1: Content depth and scientific accuracy

Question 1: How do you evaluate each DIEP content level and academic depth? Did you find them sufficient and meaningful for gifted students? Please explain.

Teachers' overall assessment within the scope of the first sub-problem is that the three AI tools (ChatGPT, Gemini, DeepSeek) have different strengths and weaknesses in terms of the content level and academic depth of the DIEP they prepare. However, the vast majority of participants found the DIEP prepared by ChatGPT ($X=4.16$) to be the strongest and most meaningful in terms of both content diversity and academic integrity (Figure 1).

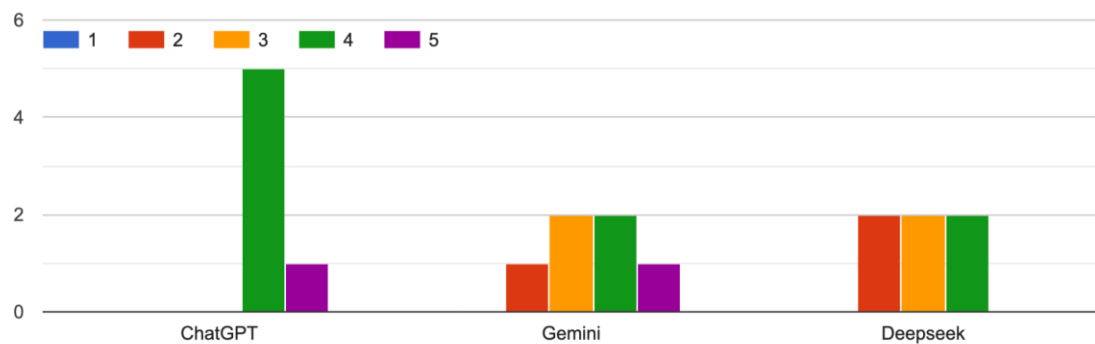


Figure 1 Content Level and Scientific Accuracy

Teachers (T1) described ChatGPT's program as *"designed to attract the interest of gifted students and provide them with the opportunity to deepen their knowledge step by step."* (T2) emphasized that the program offers *"8 months of flexible and detailed planning, an open-ended and interdisciplinary framework,"* with individualization at the forefront. Similarly, (T4) stated that *"ChatGPT is based on different theoretical foundations and creates a plan that enables students to deepen their knowledge through original approaches and technology integration."* (T5) stated that the program has an explanatory and developable structure due to *"the framework of each month being outlined and guidance being provided according to the student profile."* (T6) emphasized that the program *"goes beyond ordinary teaching programs, enabling students to discover, prove, generalize, and creatively expand the concept."* These statements show that teachers evaluate ChatGPT DIEP not only as a knowledge transfer tool

but also as a deep learning model that includes mathematical thinking, proof, and generalization processes.

Teachers generally found the Gemini DIEP (T4) to be *"appropriate for the student level and pedagogy,"* but evaluated it as more traditional and limited in terms of content. One teacher (T2) noted that the Gemini DIEP *"uses advanced geometry topics considering Van Hiele levels of thinking" but "progresses at a more conceptual level."* Other teachers shared the view that the program is *"in the style used in schools" (T3), "weak in terms of differentiation," and "does not include enriched activities for gifted students."* (T5) found Gemini's *"allowing discovery-based learning and encouraging advanced mathematical thinking"* to be positive; however, they noted that the activity *"may lose its meaning if it does not fully match the students' readiness level."* Therefore, Gemini DIEP was evaluated as pedagogically consistent but limited in its ability to respond to the deepening and original production needs of gifted students.

Teacher opinions indicate that DeepSeek DIEP draws attention with its interdisciplinary aspect but is considered insufficient in terms of mathematical depth. (T3) stated that the program *"offers content that is creative, related to daily life, and focused on the student's interests, and includes different levels of difficulty, such as two-point perspective and dynamic set design";* from this perspective, he found the program sufficient in terms of content level. However, other participants (T2, T4) emphasized that the program is *"not appropriate for the ÜYG (development according to learning experience) stage"* and that its *"mathematical depth is weak."* One teacher (T2) stated that although DeepSeek *"deals with original themes such as origami, non-Euclidean geometry, and graph theory, it fails to establish connections between them."* These findings show that DeepSeek is considered a program that is rich in creativity and aesthetics but superficial in terms of conceptual integrity and depth.

All teachers indicated that teacher guidance is a decisive factor in the applicability of DIEP. (T3) stated that *"without teacher explanations following student responses, different interpretations may arise in practice."* Similarly, (T4) emphasized that *"a teacher guide is needed for the implementation of all three programs."* This situation shows that while the DIEPs prepared by AI tools are pedagogically valuable, they become meaningful only when complemented by teacher support and an adaptation process.

The general opinion of the participants regarding Question 1 is that the DIEP prepared by ChatGPT has the most in-depth, comprehensive, and systematic content structure for gifted students. The Gemini DIEP was found to be pedagogically balanced but limited in terms of

originality and depth, while the DeepSeek DIEP was found to be creative but fragmented and superficial. Teachers emphasized that all AI tools are valuable in terms of idea generation and enrichment; however, teacher guidance, level adaptation, and content integrity are necessary for DIEPs to be transferred to the classroom environment.

Theme 2: Originality and creativity

QUESTION 2: What do you think about the originality and creativity of the activities presented in the plans? Which plan impressed you the most and why?

Within the scope of the second sub-problem, participating teachers found the DIEP created by ChatGPT to be more impressive than other tools in terms of originality, creativity, and student- centeredness ($X=3.83$) (Figure 2).

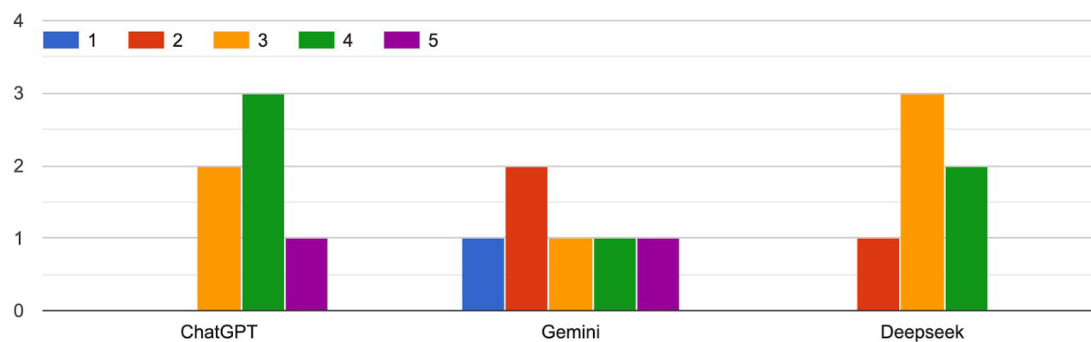


Figure 2 Creativity and Originality

Participants highlighted aspects such as the program's interdisciplinary connections, the opportunity to use dynamic software, and its adoption of an inquiry-based learning approach. (T1) noted that *although the program's "mathematical content was not sufficiently original, the tools and technological support used made the process creative."* Similarly, (T2) stated that the program *"focuses on interdisciplinary, curiosity-inducing content" and "appeals to the curiosity of gifted students."* (T3) emphasized that the program has a structure that is *"most suitable for students to delve deeper" and is "open to interaction with different dynamic software."* Another teacher (T4) evaluated ChatGPT's DIEP as *"the work with the most comprehensive benefits,"* while (T5) described this plan as *"different and noteworthy compared to the commonly heard applications in schools."* (T6) stated that the program was the most influential DIEP because it *"encourages discovery by relating a historical problem to daily life, allowing for both intuitive and proof-based thinking."*

These statements show that teachers perceive ChatGPT's DIEPs as content that engages students and encourages multi-perspective and discovery-based thinking. Teachers also emphasized that technological tools are creatively integrated into these plans, adding "applicability" to the teaching process.

Teachers stated that the DIEPs prepared by Gemini and DeepSeek contained innovative elements to a certain extent, but in general, the level of originality and creativity was limited compared to ChatGPT. (T2) stated that DeepSeek showed a different orientation by using "*Olympic-focused problems*," while Gemini contained "*technology-focused and inquiry-based problems*," but this aspect was not sufficiently deepened. Similarly, (T3) stated that although all three programs have potential, "*the only program prepared at a level that challenges students belongs to ChatGPT*."

In general, teachers' opinions are that Gemini and DeepSeek DIEPs do not offer original content that triggers student curiosity and productivity, while ChatGPT DIEP stands out with creative problem situations and visual-applied approaches.

The general finding regarding Question 2 is that all teachers evaluate ChatGPT's DIEP as the most original and creative plan. For ChatGPT, it is seen that it activates students' intuitive, proof-based, and critical thinking skills and responds to the curiosity, discovery, and productivity needs of gifted students through interdisciplinary contexts and technology integration. Gemini and DeepSeek, while possessing "creative potential," were found to be more "close to existing teaching approaches" and "limited in their innovative dimensions" in practice.

Theme 3: Appropriateness to student interests and needs

QUESTION 3: Evaluate the suitability of the content and activities in DIEPs for the interests, needs, and ability levels of gifted students.

Within the scope of the third sub-problem, the vast majority of teachers emphasized that the DIEP created by ChatGPT is the most suitable program ($X=4.16$) for the cognitive, affective, and interest characteristics of gifted students (Figure 3).

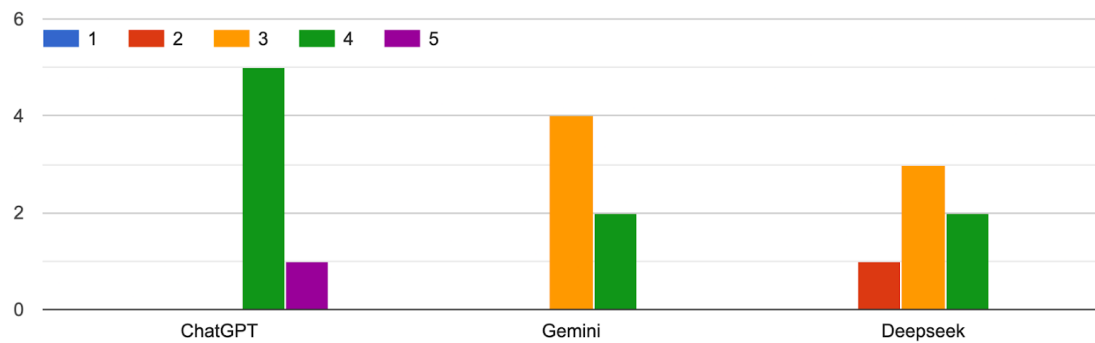


Figure 3 Suitability for Student Level

Participants stated that the program took into account the student's interest in geometry, individual study tendencies, and learning speed (T2); they stated that it *"enriched problems according to the student's interest"* and offered *"research projects with inquiry-based proof activities."* (T4) emphasized that *"the student's interest in geometry and the annual program being organized accordingly can meet the student's needs."* Similarly, (T6) stated that ChatGPT *"can attract the student's interest by progressing through a problem related to daily life."*

These findings show that teachers perceive ChatGPT's program as individualized, interest-based, and providing cognitive depth. However, (T3) also stated that the program *"may be challenging for middle school students due to advanced geometry topics."* This situation can be interpreted as meaning that while the program is suitable for gifted students, it requires adaptation for age and level.

Some teachers noted that the program developed by Gemini is pedagogically strong, particularly because it (T2) *"takes into account Van Hiele levels of thinking"* and (T6) *"addresses classical geometry topics suitable for analytically intelligent students,"* meaning it can appeal to specific student profiles. However, the program's overall structure has been assessed as *"traditional and difficult to implement"* (T5). Teachers have stated that Gemini does not offer creative or differentiated activities that would sustain students' interest and curiosity for long periods.

These findings show that although Gemini is pedagogically partially suitable for the thinking styles of gifted students, it does not fully meet their creativity and differentiation needs.

Teachers found DeepSeek's program to be designed to appeal to students with a profile that is particularly (T6) *"interested in mathematics and art."* However, criticisms such as (T2)

"difficult topics that appear fragmented" and (T5) "not geared towards deep knowledge acquisition" stood out throughout the program. While some teachers (T3, T5, T6) thought the program's interdisciplinary and aesthetic aspects" could attract students' interest, most teachers (T2, T3, T5) pointed out the lack of scientific depth and conceptual continuity.

Therefore, DeepSeek was evaluated as a program with potential in terms of creativity and establishing aesthetic connections, but one that does not sufficiently meet the cognitive deepening needs of gifted students.

According to the teacher opinions obtained with Question-3, the programs prepared by the three AI tools generally show a certain degree of suitability for the learning profile of gifted students. However, ChatGPT's DIEP stood out with its individualized learning opportunities, consideration of the student's interests, and discovery-based activities. Gemini's DIEP, while consistent in its pedagogical framework, is limited in terms of creativity and differentiation; DeepSeek's DIEP, on the other hand, is notable for its aesthetic and interdisciplinary approach but is found to lack depth.

These findings show that AI tools have the potential to respond to the needs of gifted students, but require teacher guidance and level adaptation prior to implementation.

Theme 4: Differentiation and individualization

QUESTION 4: Which AI program's DIEP was stronger in terms of differentiation and individualization? Why ?

Participants assessed ChatGPT as the strongest AI tool ($X=4.5$) in terms of differentiation and individualization within the scope of the fourth sub-problem (Figure 4).

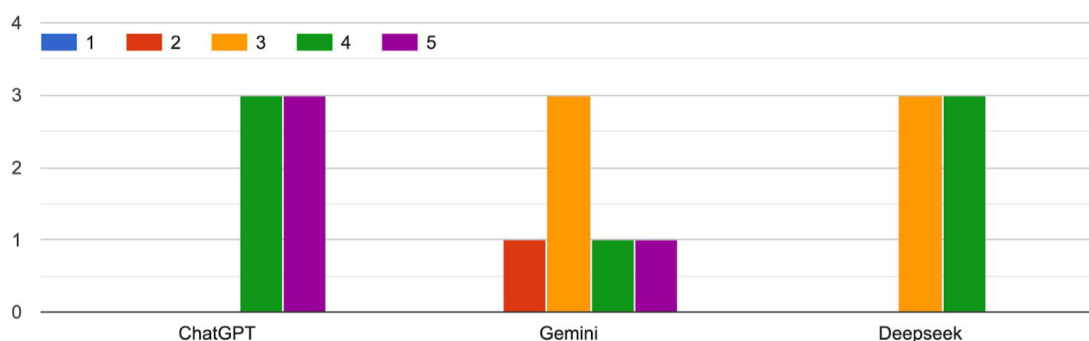


Figure 4 Level of Differentiation and Individualization

Teachers emphasized that the ChatGPT program has a flexible, multi-layered structure that encourages deep thinking according to the student's level. One teacher (T2) stated that

ChatGPT *"demonstrated a stronger differentiation approach in the learning process and in producing learning outcomes"* and expressed that *"interdisciplinary content, individuality, and inquiry content"* enriched the plan. Similarly, (T3) emphasized that the program *"contributes to students' deep thinking through open-ended questions in the warm-up and construction steps and offers the teacher opportunities for differentiation."*

Other participants (T4) similarly noted that the program is theoretically grounded, has clearly defined objectives, and (T6) has a structure that can adapt to the student's individual pace through interdisciplinary activities. (T5) emphasized that ChatGPT *"offers a unique example of differentiation with its consistency and depth across activities."* These views reveal that teachers see ChatGPT as a powerful tool not only for its content diversity but also for its capacity to personalize the learning process.

(T1) described the program prepared by Gemini as *"the closest to individualization"* and noted that it *"offers more options that can capture students' attention."* This assessment shows that Gemini has the potential to offer flexible learning paths and areas of choice in terms of individualization. However, other teachers did not emphasize this aspect in their statements, and Gemini was generally seen as having a more superficial level of differentiation compared to ChatGPT.

Participants stated that DeepSeek's differentiation approach was weak. Specifically, (T5) stated that *"deepening the topic of abstract algebra through puzzles and games is inconsistent"* in the DeepSeek program, indicating that the program's content-purpose alignment is weak. This situation can be interpreted as DeepSeek, despite containing creative ideas, being insufficient in meeting the in-depth learning needs of gifted students.

In general, teachers agree in Question 4 that ChatGPT has a clear advantage in terms of differentiation and personalization. This DIEP enables students to progress at their own pace, generate content based on their individual interests, establish interdisciplinary connections, and develop original projects. While Gemini's DIEP offers certain flexibilities in terms of individualization, it is limited in depth; DeepSeek's DIEP, despite its innovative ideas, is found to be weak in terms of application integrity.

These findings demonstrate the potential of AI tools to generate DIEPs, while showing that the most effective output emerges from ChatGPT's DIEP, which is based on pedagogical foundations and supports multidimensional thinking processes.

Theme 5: Ease of implementation

QUESTION 5: *From the perspective of a practicing teacher, which program do you think can be implemented more easily and effectively in the classroom? Why? Please explain.*

Teachers indicated that the program that could be implemented most easily and effectively in the classroom environment was the DIEP prepared by ChatGPT ($X=3.83$) (Figure 5).

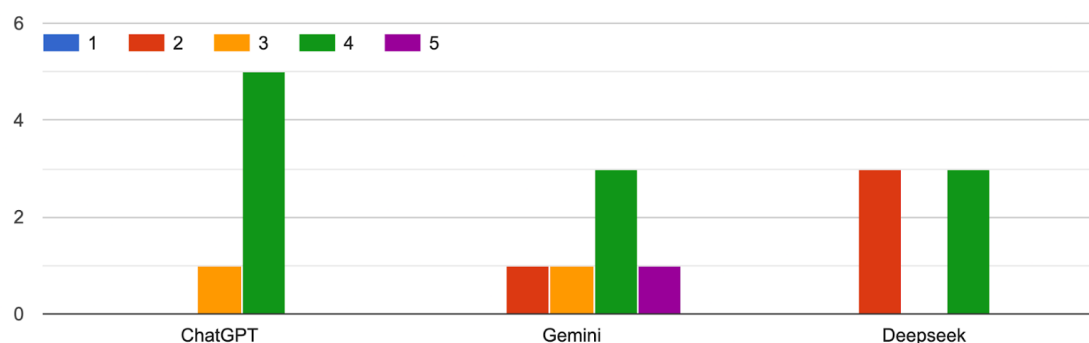


Figure 5 Applicability and Transferability to the Classroom Environment

Participants emphasized that ChatGPT DIEP is more applicable than other tools, both because it has a gradual level of difficulty in content transitions and because the application steps are clear. (T1) drew attention to the systematic structure of the program, stating, *"The difficulty level of the transitions was more gradual in terms of content, and the design of a sample week was also provided in a more structured and applicable way."* Similarly, (T2) found the ChatGPT program effective in terms of *"establishing interdisciplinary connections and enabling students to produce different products (writing, proofs, digital presentations, posters, etc.),"* while (T3) stated that *"the clarity of the application steps made it more applicable for teachers."* (T6) stated that the program could be used effectively in the classroom environment *because it "allows students to explore through trial and error both on paper and in a computer environment."*

These views show that ChatGPT DIEP offers a flexible yet guiding framework in the teaching process, providing teachers with ease of adaptation and pedagogical support. One teacher (T4) stated, *"Although the ChatGPT plan looks good on an annual basis, it may not be easy to fully implement in the classroom; therefore, from an implementing teacher's perspective, GEMINI is easier to implement."* This view shows that Gemini could provide practical ease due to its simpler and more time-manageable structure. However, this ease is

limited in terms of deep learning or original production, as noted by other teachers. Therefore, the Gemini program is seen as advantageous in terms of ease of implementation but as a superficial alternative in terms of learning depth.

Some teachers indicated that DeepSeek DIEP could be adapted to lower grade levels and used effectively in this way. (T5) pointed to the flexibility potential of this tool, stating, *"The ChatGPT activity may be effective because it appeals to original and higher-level thinking; DeepSeek, on the other hand, can be modified to suit a lower-level group because it is more superficial."* However, in general, DeepSeek was less preferred than ChatGPT and Gemini in terms of ease of application.

The teacher opinions in Question 5 clearly show that ChatGPT's DIEP offers a pedagogically structured, step-by-step, interdisciplinary, and applicable framework. The program's ability to both support the teacher's guiding role and allow space for the student's experiential learning and product creation processes makes it stronger than other tools. While Gemini's DIEP is seen as an easier DIEP in terms of time management in the classroom, DeepSeek's DIEP is evaluated as a tool that requires adaptation but has potential.

As a result, teachers see the DIEP prepared by ChatGPT as the most powerful tool due to its ease of application, flexibility, and capacity to produce effective learning outcomes.

Theme 6: Educational and technological consistency

QUESTION 6: Which DIEP did you find to be more pedagogically consistent and technologically equipped? Why? Please explain.

Within the scope of the sixth sub-problem, teachers emphasized that the pedagogically most consistent ($X=4.16$) (Figure 6) and technologically most equipped ($X=4.0$) (Figure 7) DIEP was the program prepared by ChatGPT.

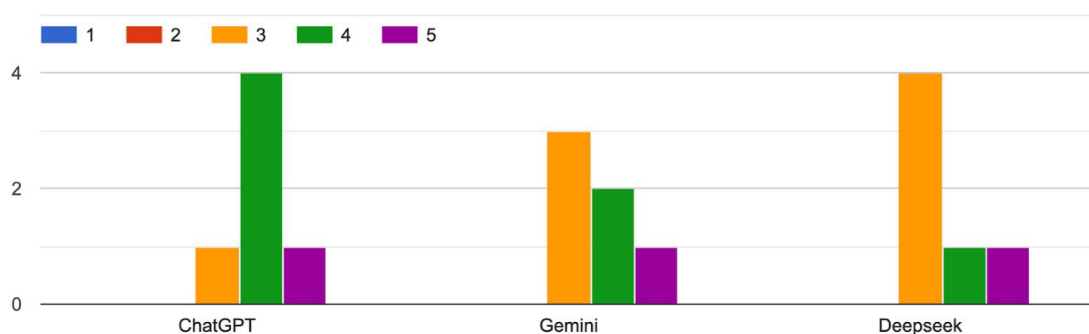


Figure 6 Pedagogical Consistency

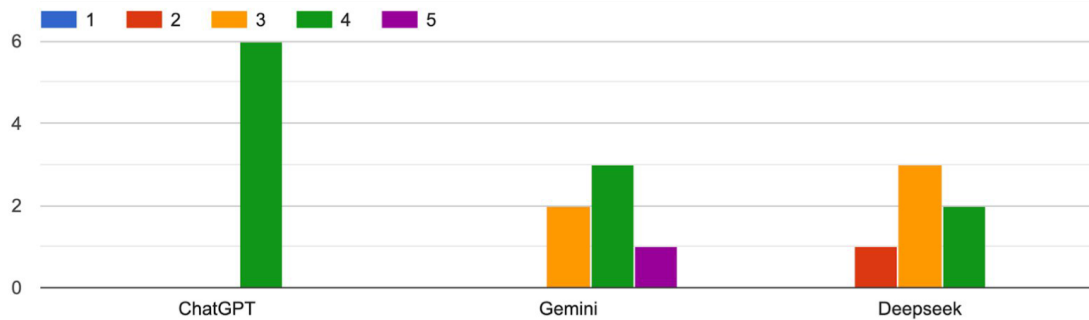


Figure 7 Technological Adequacy (Digital, Content, Resource Usage, etc.)

Participants noted that ChatGPT DIEP stood out for integrating different theoretical frameworks, incorporating student-centered learning processes, and integrating various digital tools (GeoGebra, Desmos, Tinkercad, Scratch). One teacher (T2) stated that ChatGPT DIEP *"strongly relates theoretical frameworks such as Renzulli, VanTassel-Baska, Bloom, and Krutetskii"* and that the program offers a *"spiral structure appropriate to the structure of the discipline of mathematics."* Similarly, (T3) stated that ChatGPT is *"more equipped because it includes different models such as Renzulli, Bloom, and VanTassel-Baska"*; (T5) stated that *"the framework program and activities form a consistent, rich, and original"* whole. (T4) emphasized that the program is pedagogically grounded in that it *"provides different software programs (e.g., GeoGebra, Scratch) as resources and supports them with written text resources."* Furthermore, (T6) stated that the program is strong both technologically and pedagogically thanks to the *"clear expression of the application process in GeoGebra and the inclusion of guidelines for students to deepen their understanding and question using technology."* These views show that ChatGPT DIEP offers a pedagogical approach that integrates technology meaningfully into the teaching process, rather than using it merely as a tool.

(T6) described Gemini DIEP as *"more equipped and well-articulated in every step"* from a technological perspective. This view gives the impression that Gemini DIEP presents technology use in a more systematic way, integrated into teaching steps. However, the same teacher noted that the program is *"suitable for higher-level students,"* indicating that there may be limitations in applicability for the general student profile at this level. Other teachers found the technological dimension of the Gemini DIEP sufficient but not as strong as the ChatGPT DIEP in terms of pedagogical integrity.

Participants emphasized that DeepSeek DIEP did not contain sufficient explanations regarding the use of technological tools. (T6) drew attention to this shortcoming, stating that *"there was not enough explanation on how to apply the technological tool in the activity."* It was also stated that the program could create problems in terms of suitability for the student level because it *"requires a more advanced level of knowledge"* from a pedagogical perspective. These findings show that the technology integration of the DeepSeek DIEP remained superficial and that it may be difficult to implement the program pedagogically *"without teacher guidance."*

According to the teachers' opinions in Question 6, ChatGPT DIEP is the most consistent and well- equipped DIEP in both pedagogical and technological terms. The program's meaningful integration of multiple theoretical models (Renzulli, Bloom, VanTassel-Baska, Krutetskii); positioning technology tools not merely as a supporting element but as part of the learning process; and ensuring systematic coherence in terms of content, process, and assessment highlight these strengths. Although Gemini DIEP offers a technologically equipped and systematic structure in certain steps, it is not considered as strong as ChatGPT DIEP in terms of pedagogical depth. DeepSeek DIEP, on the other hand, contains innovative ideas but has been evaluated as lacking in terms of technology integration and pedagogical guidance.

As a result, teachers stated that ChatGPT DIEP is the most comprehensive and balanced program in terms of both instructional design and technology integration; therefore, it stands out as the most applicable and innovative tool in the education of gifted students.

Overall, all teachers (n=6) stated that they would prefer ChatGPT DIEP. The reasons for this preference were summarized as a strong theoretical framework, an interdisciplinary approach, educational consistency, and effective integration of technology. However, some teachers stated that they found Gemini DIEP more applicable and that DeepSeek DIEP offered a unique perspective.

Conclusions and Suggestions

This study examined the usability of DIEPs generated by three different AI tools (ChatGPT, Gemini, and DeepSeek) in the education of gifted students based on teacher opinions. The findings show that teachers generally found the DIEP prepared by ChatGPT to be stronger than other AI tools in terms of content depth, pedagogical consistency, individualization, and technological integration. Gemini DIEP was found to be advantageous

in terms of pedagogical balance and practical applicability, but was evaluated as limited in terms of originality and depth. DeepSeek DIEP stood out in terms of establishing interdisciplinary connections and offering creative activities, but was considered insufficient in terms of conceptual integrity, depth, and application guidance.

The multi-layered structure of the DIEP produced by ChatGPT, which integrates different theoretical frameworks (e.g., Renzulli, Bloom, Van Tassel-Baska, Krutetskii), was considered by teachers to be the program's strongest aspect. This demonstrates that AI tools can play a meaningful role not only in content production but also in pedagogical structuring processes. The findings reveal that ChatGPT DIEP supports students' concept discovery, proof, and generalization processes, thus offering a teaching design consistent with deep learning and constructivist approaches (Vygotsky, 1978). Furthermore, recent research shows that AI can increase learner autonomy and support individual learning paths in the enrichment of teaching materials (Ayeni et al., 2024; U.S. Department of Education, 2023). Similarly, this study demonstrates that AI-supported plans can make a meaningful contribution to the learning process through content depth.

Teachers rated the ChatGPT-generated differentiated education program as notably advanced in terms of originality and creativity. The program's integration of interdisciplinary contexts, historically grounded problem situations, and dynamic digital tools reflects key affordances of artificial intelligence-supported learning environments, which have been shown to promote learner curiosity, cognitive engagement, and productive exploration through generative and adaptive content design (Luckin et al., 2016; Holmes et al., 2021). This finding is consistent with previous research (Johnsen, 2025; Renzulli, 2012; Sternberg & Williams, 1996) emphasizing that enriched teaching environments supporting creative thinking and problem-solving skills are crucial in gifted education.

Although Gemini and DeepSeek DIEPs contain original elements, they lack pedagogical frameworks that deeply support creative thinking. As noted by Yan et al. (2023), the originality of instructional content generated by large language models can remain superficial when not supported by teacher guidance and verification processes.

The findings show that the ChatGPT DIEP best reflects the principles of differentiation and individualization. The DIEP's flexible structure, which adapts to the student's pace, interests, and cognitive capacity, has been evaluated by teachers as the most suitable approach for the needs of gifted students. This aligns with the principles of differentiated instruction proposed by Tomlinson (2014). Furthermore, studies by Chiu et al. (2023) and Ayeni et al.

(2024) emphasize that the capacity of AI tools to create personalized learning experiences achieves the greatest impact when combined with teacher guidance. This research supports these findings and demonstrates that ChatGPT DIEP can be a powerful personalized teaching tool when implemented through teacher-AI collaboration.

Almost all teachers rated ChatGPT DIEP as the most pedagogically consistent and technologically equipped DIEP. The DIEP's integration of digital tools such as GeoGebra, Desmos, Tinkercad, and Scratch into pedagogical processes takes technology use beyond a merely instrumental level. While the Gemini DIEP offers a systematic structure in terms of technology integration at certain stages, it remains limited in terms of pedagogical depth; the DeepSeek DIEP, on the other hand, has been evaluated as an innovative but superficial application example. This situation aligns with the principles of pedagogy-centered technology design emphasized by Holmes et al. (2021), which highlight the importance of integrating AI into learning processes in pedagogically meaningful ways.

The overall findings of the study show that teachers evaluated the DIEP generated by ChatGPT as the strongest program in terms of content, differentiation, originality, and technology integration. Gemini DIEP has advantages in pedagogical balance and practical applicability, while DeepSeek DIEP has innovative potential with its aesthetic and interdisciplinary perspective. However, the effective use of all three tools depends on the presence of teacher guidance, level adaptation, and pedagogical direction processes.

In conclusion, AI tools have the potential to offer individualized, creative, and deepened learning experiences in the education of gifted students. However, it is evident that AI teaching programs and plans used independently of teacher guidance will have limited effects. This finding supports the principle of "AI-assisted instruction only under teacher leadership" emphasized in the U.S. Department of Education (2023) report.

Recommendations

Based on the findings of this research, the following recommendations are made for the effective and pedagogically meaningful use of AI tools in gifted education. AI-based instructional design requires not only technological proficiency but also pedagogical and ethical awareness. Therefore, it is recommended that teachers participate in in-service training programs on using AI tools for educational purposes, preparing appropriate prompts, and evaluating the reliability of AI outputs.

The findings show that teacher guidance is decisive in the applicability of AI tools. In future studies, it is recommended that hybrid content creation models (e.g., the "design with AI" approach), in which teachers and AI jointly produce content, be developed to make teaching processes more dynamic and interactive.

Each AI tool (ChatGPT, Gemini, DeepSeek) has different strengths. Multi-system approaches that use these tools together can produce more qualitative results in terms of both originality and depth. Therefore, platforms and guidance documents should be developed that enable teachers to use different AI tools in a synchronized manner.

Pilot projects for AI-supported DIEP designs can be launched in institutions such as BİLSEM. The data obtained during this process can guide program development and teaching program differentiation processes.

The use of AI tools in education also requires attention in terms of data security, originality, and intellectual property. In this context, it is recommended that clear ethical guidelines and verification processes be established for the use of AI-based content.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest

The authors declare that they have no conflict of interest.

Funding

This research received no external funding.

CRedit author statement

Burak Karabey: Conceptualization, supervision, project administration, validation

Arzunur Çakmak: Data collection (survey), data curation, formal analysis, writing – original draft preparation, writing – review and editing

Yağmur Günay: Data collection (survey), data curation, formal analysis, writing – original draft preparation, writing – review and editing

Research involving Human Participants and/or Animals

Research approved by the Social and Human Sciences Scientific Research and Publication Ethics Committee at Dokuz Eylül University, under decision no. 19.03.2025/10.

Matematik Öğretmenlerinin Üstün Yetenekli Öğrenciler için Yapay Zekâ ile Geliştirilen Farklılaştırılmış ve Bireyselleştirilmiş Eğitim Programlarına İlişkin Görüşlerinin İncelenmesi

Özet:

Yapay zekâ (YZ) teknolojilerinin eğitim alanındaki hızlı gelişimi, bireyselleştirilmiş öğrenme ve öğretim tasarımı yeni fırsatlar sunmaktadır. Bu araştırmanın amacı, üç farklı YZ aracının (ChatGPT, Gemini ve DeepSeek) üstün yetenekli öğrencilerin eğitiminde kullanılabilecek Farklılaştırılmış ve Bireyselleştirilmiş Eğitim Programı hazırlama yeterliklerini, öğretmen görüşleri doğrultusunda incelemektir. Araştırma, temel nitel araştırma deseni ile yürütülmüş; katılımcı grubunu Türkiye'deki Bilim ve Sanat Merkezlerinde görev yapan altı ortaokul matematik öğretmeni oluşturmuştur. Veriler, araştırmacılar tarafından geliştirilen yarı yapılandırılmış görüşme formu aracılığıyla toplanmış; öğretmenlerden her bir YZ aracını belirlenen ölçütlerde 1–5 arası Likert tipi puanlamaları ve görüşlerini açıklamaları istenmiştir. Bulgular, ChatGPT'nin içerik ve akademik derinlik, özgünlük ve yaratıcılık, öğrenci ilgi ve ihtiyaçlarına uygunluk, farklılaştırma ve bireyselleştirme, uygulama kolaylığı, eğitsel ve teknolojik tutarlılık, açısından diğer araçlara göre daha güçlü bulunduğunu göstermektedir. Değerlendirmelerde Gemini pedagojik olarak dengeli, DeepSeek ise disiplinler arası yönüyle yenilikçi ancak kavramsal açıdan yüzeysel bulunmuştur. Sonuç olarak, YZ araçlarının öğretmen rehberliğiyle birlikte kullanıldığında üstün yetenekli öğrencilerin eğitiminde bireyselleştirilmiş ve farklılaştırılmış öğrenme deneyimleri sunma potansiyeline sahip olduğu belirlenmiştir.

Anahtar kelimeler: Yapay zekâ, üstün yetenekliler eğitimi, farklılaştırılmış eğitim programı, BİLSEM, matematik eğitimi.

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