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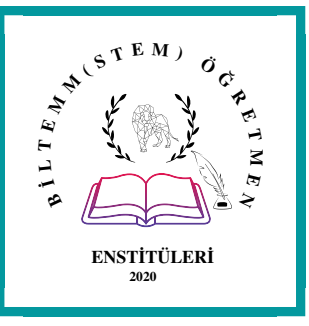

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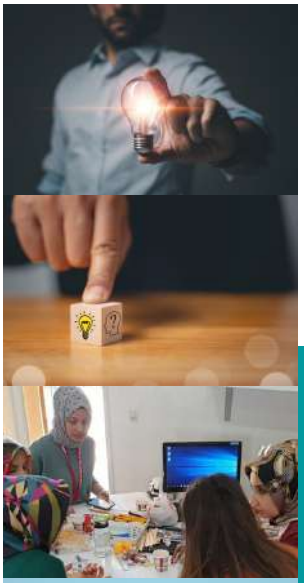

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Teacher Candidates' Metaphorical Perceptions of ChatGPT

Ahmet Aykan[1].

Abstract

This study aims to explore teacher candidates' metaphorical perceptions of ChatGPT, a language model based on artificial intelligence, by examining the attitudes, expectations, and concerns they hold toward this emerging technology in a comprehensive manner. Adopting a phenomenological approach from the qualitative research tradition, the study included 220 senior-year teacher candidates enrolled in a Faculty of Education at a university. As the data collection tool, a Metaphor Generation Form was developed, prompting participants to complete the statement "ChatGPT is like … because …," followed by open-ended questions about why they chose these metaphors. Results of the content analysis reveal that participants most frequently characterize ChatGPT positively through metaphors such as a "Knowledge Repository" and an "Assistant/Guide." Conversely, metaphors like "Black Box/Unfathomable Power" highlight concerns regarding reliability and transparency in this technology. Furthermore, the theme of a "Magic Wand/Miracle" signifies teacher candidates' high expectations for ChatGPT. When examining the rationale behind the metaphors, it becomes clear that, alongside positive factors like speed and variety, there are notable reservations related to ethics and academic integrity. According to a classification of positive, negative, and neutral attitudes, half of the participants view ChatGPT as beneficial and supportive, whereas roughly one-third remain skeptical or negative due to reliability and ethical issues. Demographic variables (e.g., academic department, familiarity with technology) also shape these metaphorical perceptions; notably, those with higher technological literacy adopt a more optimistic outlook on ChatGPT. These findings suggest that while teacher candidates consider both the potential benefits and ethical-technical risks of AI-based tools like ChatGPT in educational contexts, additional pedagogical and ethical frameworks are necessary for successful integration. The study underscores the importance of AI literacy in future teacher education curricula and suggests that practical coursework and ethical-awareness activities could foster a more informed and responsible stance toward AI technologies.

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Introduction

Rapid developments in artificial intelligence (AI) have accelerated digitalization and technological transformation within education systems (Russell & Norvig, 2010). In this context, AI models trained on large datasets bring novel perspectives to teaching and learning through data-processing and interpretation capabilities (Baker & Yacef, 2009). Notably, extensive language models such as ChatGPT have come to the forefront for their capacity to guide users, provide answers, and generate diverse outputs, from academic research to everyday information queries (Brown et al., 2020). By analyzing complex questions and responding in a comparatively natural linguistic flow, ChatGPT diverges from traditional chatbots and is thought to offer teachers and students a dynamic learning environment (Zhai, 2022).

Teacher candidates' attitudes and perceptions concerning the use of technology in their future professional practices directly influence the quality of classroom instruction (Koehler & Mishra, 2009). Indeed, effectively employing technology for pedagogical aims relates closely to the cognitive and affective processes teacher candidates develop toward these tools (Davis, 1989). Advanced language models such as ChatGPT bring advantages like creating learning materials, offering rapid feedback, and producing content suited to various learning styles. However, potential pitfalls arise, including possible misinformation, ethical concerns (plagiarism, copyright infringement), and shifts in the quality of teacher-student interactions (Selwyn, 2019). Consequently, how teacher candidates perceive these AI-based tools and position them in their professional roles constitutes an essential indicator of how future educational systems will utilize technology.

Metaphor analysis serves as a valuable method for uncovering individuals' perceptions, ideas, and emotions regarding specific concepts or phenomena (Lakoff & Johnson, 1980). Within the field of educational sciences, metaphor studies are frequently employed to examine the deep-seated meanings teacher candidates assign to concepts such as "student," "teaching," or "technology" (Saban, 2008; Saban, 2009). This investigation focuses on the metaphorical perceptions teacher candidates hold about ChatGPT, aiming to understand how they conceptualize this new AI-based technology. By doing so, the study seeks to develop insights into ChatGPT's potential uses in education and identify teacher candidates' needs for technology literacy. The central objective is to answer "Which metaphors do teacher candidates employ for ChatGPT, and what rationales underpin these metaphors?" and, based on the findings, propose suggestions for future AI adoption in education. Hence, the goal is to present a detailed profile of teacher candidates' attitudes toward ChatGPT and provide crucial insights into how AI-powered technologies can be accepted and integrated into educational contexts.

Artificial Intelligence and ChatGPT

AI draws upon advances in big data, machine learning, and natural language processing, offering innovative solutions across many sectors—including education (Russell & Norvig, 2010; Baker & Yacef, 2009). Such solutions aim to enhance learning processes, deliver personalized feedback, and boost student performance (Holstein, Aleven, & Rummel, 2023). As technological infrastructure becomes more accessible, AI-based systems can be widely implemented in the educational sector.

The development of Large Language Models (LLMs) has expanded the capabilities of chatbots, enabling them to handle more complex tasks with greater versatility. Among these, ChatGPT stands out for its revolutionary progress in natural language processing (Brown et al., 2020). Distinguishing itself from traditional chatbots, ChatGPT has been trained on extensive datasets to learn the structural and semantic properties of language; it can thus produce coherent answers to sophisticated queries and generate text that approximates human output.

In education, ChatGPT holds great promise for offering students immediate and interactive feedback, assisting teachers with lesson planning, and supporting assessment processes (Henrickson, 2023). In an era of widespread remote and hybrid learning, ChatGPT's real-time interactions can enhance student motivation and personalize their learning experiences (Zhai, 2022). However, the model's inner mechanisms (algorithmic transparency), the accuracy of the generated information, and data privacy issues have raised various debates on the sustainability of using ChatGPT in education (Bender et al., 2021).

Likewise, ethical considerations tied to ChatGPT are also under scrutiny. Potential bias, copyright queries, and academic integrity guidelines raise questions about how students should use this technology, to what extent, and under what conditions (Caswell & Liang, 2022). It is thus imperative that schools and universities not only provide the infrastructure necessary for AI-based tools but also supply awareness-building and training programs directed at both teachers and students (Holstein, Aleven, & Rummel, 2023). Recent research suggests that ChatGPT can be a vital resource for developing "AI literacy" (Kim & Lee, 2023). Therefore, for ChatGPT to be successfully integrated into an educational ecosystem, ethical, pedagogical, and technological dimensions should be addressed simultaneously (Bender et al., 2021).

Teacher Candidates and ChatGPT

Teacher candidates constitute the future professional cadre of education systems, shaping how technology is utilized in classrooms (Koehler & Mishra, 2009). The presence of AI-based tools, particularly ChatGPT-like large language models, in teacher education programs exerts substantial influence on both the professional growth of these candidates and their pedagogical competencies (Kim & Lee, 2023). Understanding teacher candidates' perceptions, attitudes, and expectations about ChatGPT is thus critical for forming sound educational policies and best practices (Holstein, Aleven, & Rummel, 2023).

Existing research underscores that teacher candidates' technology adoption processes are predominantly influenced by perceived usefulness, ease of use, and self-efficacy (Davis, 1989). In the case of advanced AI tools like ChatGPT, additional elements—such as ethics, data privacy, academic honesty, and the reliability of provided information—also come into play (Henrickson, 2023). While teacher candidates acknowledge the value these technologies bring, they may worry that the ease of access provided to students could undermine their critical thinking and research skills (Zhai, 2022).

Concurrently, ChatGPT shows potential in enhancing candidates' pedagogical capacities—specifically in developing lesson content, creating alternative question banks, and producing resources tailored for different learning styles (Kim & Lee, 2023). Nevertheless, candidates are advised to cultivate a critical viewpoint regarding the accuracy and currency of ChatGPT's responses (Bender et al., 2021). Studies have indicated that teacher candidates' perceptions of ChatGPT largely depend on their level of technology literacy and prior experience with digital pedagogical tools (Holstein, Aleven, & Rummel, 2023). Candidates who possess stronger digital competencies tend to see ChatGPT more favorably, whereas those with limited experience remain uncertain about its role in the classroom and its broader impact on their professional identity (Henrickson, 2023).

Given these findings, teacher candidates should be guided to approach ChatGPT not solely as a data source but as a pedagogical tool and an adjunct to the teaching-learning process (Koehler & Mishra, 2009). Integrating more theoretical and practical courses on AI technologies within teacher education curricula, along with emphasizing ethical and critical dimensions, is recommended (Kim & Lee, 2023). Through such measures, teacher candidates can more consciously, effectively, and responsibly integrate ChatGPT and similar AI tools into their future educational practices.

Significance of Study

In contemporary education, AI-based technologies are expanding rapidly, driving a powerful transformation that may redefine the teaching profession (Holstein, Aleven, & Rummel, 2023). During this period of transition, teacher candidates' attitudes, expectations, and concerns regarding these technologies bear substantial importance, as the way they conceptualize and internalize these tools will serve as a foundation for their future classroom implementations (Kim & Lee, 2023). Models like ChatGPT hold out innovative opportunities for teacher candidates, spanning tasks such as lesson planning, assessment, resource development, and student counseling (Henrickson, 2023).

Nonetheless, apprehensions about ethical use and reliability have a decisive impact on whether candidates adopt or reject such technologies (Bender et al., 2021). Topics like academic honesty, copyright infringements, and potential bias often feature prominently in discussions about AI's educational applications, complicating the integration of these tools into learning environments. Consequently, a detailed

examination of teacher candidates' perspectives on ChatGPT becomes crucial, illuminating the motivational factors, worries, and knowledge gaps that arise (Zhai, 2022).

By revealing teacher candidates' metaphorical perceptions of ChatGPT, the present study seeks to offer a more holistic perspective on the tool's educational potential. Although research on ChatGPT's use in classrooms is steadily growing, insufficient attention has been paid to the ways teacher candidates make sense of this technology and how it intersects with their pedagogical skill sets (Holstein, Aleven, & Rummel, 2023). Therefore, this investigation both fills a gap in the literature and yields practical insights into how teacher education programs might structure AI literacy.

Further, as cutting-edge technologies like ChatGPT accelerate the shift from "teacher-centered" approaches to "student-centered" or "technology-enriched" learning paradigms (Kim & Lee, 2023), developing teacher candidates' knowledge, skills, attitudes, and beliefs becomes increasingly vital (Henrickson, 2023). Findings from this study are likely to inform not just teacher training curricula but also broader educational strategies and policies. By helping teacher candidates embrace technology with both ethical awareness and pedagogical discernment, this study aims to support the next generation of teachers as effective guides in futuristic learning environments.

Purpose of the Study

As AI-driven language models rapidly gain momentum in education, the present research intends to uncover teacher candidates' perceptions of ChatGPT, along with the motivational and cautionary factors influencing these perceptions via metaphorical expressions. In an era of digital transformation, understanding how teacher candidates conceptualize and respond to new technologies—whether with acceptance, resistance, or uncertainty—holds critical importance for shaping the sustainability of technology in education (Holstein, Aleven, & Rummel, 2023; Kim & Lee, 2023). Although ChatGPT offers tools for lesson planning, assessment, and the creation of instructional materials, it also provokes discussions about information reliability, ethical principles, and academic integrity (Bender et al., 2021).

In line with this, the main research question is formulated as: "What are teacher candidates' metaphorical perceptions of ChatGPT, and which factors shape these perceptions?" To address this, the following sub-questions are proposed:

1. Which metaphors do teacher candidates use to characterize ChatGPT?
2. What reasons and themes underlie these metaphors?
3. How do metaphorical perceptions manifest as positive, negative, or neutral attitudes?
4. To what extent do demographic variables (department, year of study, familiarity with technology) reflect in teacher candidates' metaphorical perceptions of ChatGPT?

Method

Research Design

This study employs a qualitative research design to thoroughly examine teacher candidates' metaphorical perceptions of ChatGPT. Qualitative research seeks to comprehend how individuals experience and perceive a particular phenomenon or concept in depth (Creswell, 2013). Such an approach enables a comprehensive analysis of participants' feelings, thoughts, and attitudes, thereby revealing how teacher candidates conceptualize ChatGPT within their socio-cultural and personal contexts (Merriam & Tisdell, 2016).

A phenomenological strategy was chosen as the specific research design. Phenomenology focuses on participants' subjective experiences, emotions, and meaning-making processes related to a particular phenomenon (Creswell, 2013). Accordingly, this study investigates teacher candidates' "metaphorical perceptions" of ChatGPT, exploring how they position AI-based language models and what analogies they use to describe them. Using metaphor analysis in tandem with phenomenology offers an opportunity to translate participants' abstract thinking processes into concrete indicators (Yıldırım & Şimşek, 2018).

Participants

The participants in this study consist of 220 senior-year (fourth-year) teacher candidates enrolled in a Faculty of Education at

a university. The sampling method used is purposeful sampling (Patton, 2002), which ensured the inclusion of volunteer participants from diverse departments—such as Primary School Education, English Language Teaching, and Mathematics Teaching. Restricting the study to the final year of the undergraduate program was based on the assumption that candidates at this stage would have clearer professional aspirations and more pronounced views on technology. Before data collection, participants were informed of the study's purpose, scope, and ethical processes (Creswell, 2013). Each participant was given an anonymous code (e.g., TC1, TC2, etc.), and it was emphasized that they had the option to withdraw from the study at any point.

Data Collection Tool

In this study, a Metaphor Generation Form was employed as the data collection tool to uncover teacher candidates' metaphorical perceptions of ChatGPT. The form was designed to allow participants both to complete a basic metaphorical statement, "ChatGPT is like … because …," and to justify their chosen metaphor. Additionally, several open-ended questions were included to gather teacher candidates' experiences and opinions concerning ChatGPT. Thus, beyond merely eliciting metaphorical expressions, the form also captured the feelings, thoughts, and attitudes underlying these metaphors. During the form's development, three main sections were established in line with the research topic and objectives:

Demographic Information

This section focuses on queries about the participants' department, academic year, gender, technology usage habits, and ChatGPT experience level. It was designed to investigate potential relationships between participants' metaphorical perceptions and their demographic characteristics.

Metaphor Generation

This core section asks participants to complete the statement, "ChatGPT is like … because …." Alongside producing the metaphor, participants are requested to briefly explain why they selected it. Questions such as "Why did you choose this metaphor?" and "Which emotions or thoughts led you to choose it?" aim to explore not just the metaphor itself, but also the thought processes influencing it.

Open-Ended Supporting Questions

Beyond metaphor generation, 2–3 additional open-ended questions invite teacher candidates' views on ChatGPT's potential in education, its associated risks, and its practical use in teaching. For instance, "Do you plan to use ChatGPT in your future teaching career? If so, how? If not, why?" or "Do you think ChatGPT could partially or entirely replace a teacher?" were included to prompt more comprehensive and personal assessments.

In developing the data collection tool, similar metaphor analysis studies in the literature were first reviewed (Saban, 2008; 2009; Yıldırım & Şimşek, 2018). Subsequently, input from four faculty experts was sought to ensure the items were intelligible and not leading. During a pilot phase, the form was administered to ten teacher candidates to test clarity, length, and conceptual adequacy. Based on their feedback, some items were simplified, and potentially leading statements were removed. The final Metaphor Generation Form was thus finalized as a set of ten questions.

Data Collection Procedures

Data were collected both online and face-to-face via the finalized Metaphor Generation Form. Candidates who met the sampling criteria were invited to participate on a voluntary basis. After obtaining ethical committee approval, participants underwent an informed consent procedure (Creswell, 2013). The data collection process occurred in two phases. In the first, a pilot group of approximately ten candidates completed the form to assess clarity, question length, and any potential bias (Yıldırım & Şimşek, 2018). Based on their feedback, the form was refined. In the second phase, the form was distributed to the main group of teacher candidates.

Face-to-face implementation involved handing out printed copies of the form during class sessions or scheduled intervals, giving participants around 15-20 minutes to respond. Online distribution utilized Google Forms or comparable platforms, with invitation links shared via email or social media groups (Patton, 2002). Participants were informed of their

anonymity and privacy rights throughout; the form contained no sections that disclosed personal identifying information. Each submission was assigned a numerical code (TC1, TC2, etc.) for analysis, and candidates could withdraw at any point (Merriam & Tisdell, 2016).

Data Analysis

The data were analyzed using content analysis, a qualitative approach that systematizes, interprets, and synthesizes similar responses into meaningful categories and themes (Yıldırım & Şimşek, 2018). Written statements reflecting teacher candidates' metaphorical perceptions of ChatGPT underwent the following steps (Creswell, 2013; Merriam & Tisdell, 2016):

Data Organization and Raw Text Creation

All responses were digitized and assigned unique codes (TC1, TC2, …, TC220). Demographic details (department, gender, technology usage habits, etc.) were collated in a separate file, while the metaphors and explanations served as the principal data source for content analysis (Miles & Huberman, 1994).

Coding Process

Using an open coding approach, two researchers independently extracted key words, ideas, and analogies from the metaphors and their justifications (Yıldırım & Şimşek, 2018). Once coding was complete, they compared their results and determined the inter-coder reliability. By the Miles & Huberman (1994) formula, the agreement rate was computed at 88%. Discrepancies led to further discussion, re-reading participant statements, and—when necessary—consultation with a third researcher or advisor until consensus was achieved.

Theme Identification and Categorization

The initial codes were combined based on conceptual similarities, forming themes connected to the research objectives. For instance, participants' descriptions like "unlimited source of knowledge," "library," or "sea of information" were grouped under "Knowledge Repository." Regular meetings among the research team checked the clarity of themes and the scope of each category (Merriam & Tisdell, 2016). Achieving consistency among codes and themes facilitated a holistic understanding of the data.

Interpretation of Themes and Presentation of Findings

In the final stage, the identified themes and subthemes were arranged to comprehensively represent teacher candidates' metaphorical perceptions of ChatGPT. Descriptive analysis supported by direct quotations from participants reinforced the authenticity and trustworthiness of the findings (Creswell, 2013). The analysis also examined whether metaphors indicated positive, negative, or neutral perspectives, and relationships with demographic variables (department, gender, familiarity with technology, etc.) were explored. Tables and graphs were integrated when appropriate to enhance clarity.

Ethic

This study was conducted in strict adherence to ethical guidelines to ensure the protection and confidentiality of participants' rights, as well as to maintain transparency throughout the research process. Detailed information about the study's objectives, scope, methodology, and potential risks was provided to all participating teacher candidates, and informed consent was obtained from each participant. No identifying information was collected; instead, each participant was assigned a unique code to guarantee anonymity. The collected data were stored securely in environments accessible only to the research team, and individual responses were analyzed in aggregate to prevent identification. This study was carried out in accordance with the principles of autonomy, beneficence, and justice, ensuring the privacy of the participants and the overall academic integrity of the research

Findings

Metaphors Used for ChatGPT

The study's first research question investigated the metaphors teacher candidates employ to describe ChatGPT. Data from the Metaphor Generation Form revealed how participants positioned ChatGPT, highlighting the analogies they used to explain its role. Metaphors are powerful tools for illustrating the conceptual frames individuals use for understanding phenomena (Lakoff & Johnson, 1980). The analysis produced several overarching themes, summarized in Table 1, which shows

frequently used metaphors, their repetition (frequency), percentage distribution, and direct quotations expressing participants' viewpoints.

Table 1. Teacher Candidates' Metaphors for ChatGPT, Frequencies and Exemplary Quotations
Table 1. Teacher Candidates' Metaphors for ChatGPT, Frequencies and Exemplary Quotations

Theme	Metaphor Examples	Frequency (n)	Percentage (%)	Sample Quotation (TC Codes)
Knowledge Repository	Library, digital encyclopedia, boundless ocean of data	75	34.09	"ChatGPT is like a vast library because it instantly provides different kinds of information." (TC34)
Assistant / Guide	Mentor, advisor, consultant, helper	60	27.27	"When planning lessons, ChatGPT serves as a guide that lights my way." (TC89)
Black Box / Unfathomable Power	Black box, deep well, mysterious machine	40	18.18	"ChatGPT is like an uncontrollable black box; sometimes I see answers but have no clue where they really come from." (TC112)
Magic Wand / Miracle	Magic wand, miraculous fix, wizard assistant	30	13.64	"ChatGPT is like a magic wand, instantly clarifying complex topics in seconds." (TC58)
Other	Robot, mirror, joker card, bullet train, etc.	15	6.82	"ChatGPT is like a robot; it provides mechanical but effective responses as long as I give clear commands." (TC9)

As shown, Knowledge Repository (34.09%) is the most common theme, with participants perceiving ChatGPT as a broad reference source for diverse and immediate information. This suggests teacher candidates value the speed and variety of ChatGPT's data retrieval. Assistant / Guide (27.27%) indicates ChatGPT's perceived role as more than a mere informational tool; it also serves in developing lesson plans, generating questions, or providing unique teaching ideas. Notably, teacher candidates frequently invoke the words "mentor" and "guide," underscoring the potential of AI-based technologies in teaching and learning (Henrickson, 2023). In contrast, Black Box / Unfathomable Power (18.18%) highlights candidates' worries regarding the technology's opaque inner workings and data veracity—reflecting a degree of uncertainty and skepticism about how AI systems produce their responses (Bender et al., 2021). Magic Wand / Miracle (13.64%) demonstrates substantial enthusiasm or "awe" for ChatGPT's rapid and user-friendly capabilities. Yet this perspective sometimes coincides with unrealistic expectations that might lead to disillusionment if potential limitations are not acknowledged. Finally, the Other category (6.82%) covers a variety of metaphors (e.g., "robot," "joker card") suggesting teacher candidates' multifaceted impressions and experiences with ChatGPT.

Reasons Behind the Metaphors

The second research question probed the motivations and thematic frameworks shaping participants' chosen metaphors. In their descriptive comments, teacher candidates clarified how ChatGPT might benefit or pose challenges in educational contexts. Table 2 outlines these leading themes, their frequency, and direct quotations.

Table 2. Reasons for Metaphors and Thematic Justifications

Theme	Metaphor Examples	Frequency (n)	Percentage (%)	Sample Quotation (TC Codes)
Access to Information & Diversity	Speed, breadth, current data, navigation among different topics	70	31.82	"I think ChatGPT is like a library because I can find info on anything quickly." (TC51)

Time-Saving / Practical Utility	Streamlined lesson planning, question development, assignment checks	55	25.00	"ChatGPT, like an assistant, lightens my workload. It's especially helpful for new activity ideas." (TC102)
Reliability & Transparency Concerns	Accuracy of answers, unclear sources, potential bias	40	18.18	"I'm uneasy about not knowing how accurate it is; that's why I chose the black box metaphor." (TC88)
Tech Enthusiasm / High Expectations	Miraculous solutions, magic wand, groundbreaking innovation	30	13.64	"It can remove many challenges in teaching, so I call it a 'magic wand.'" (TC29)
Ethical Issues & Plagiarism	Student over-reliance, authenticity challenges, copyright uncertainty	15	6.82	"Students might use ChatGPT as a shortcut or cheat, which worries me. Conscious use is critical." (TC133)
Other	Robotic approach, irrelevant answers, limited experience	10	4.54	"It has no human aspect beyond commands, so it sometimes feels 'robotic.'" (TC12)
Total	-	220	100.00	-

Access to Information & Diversity (31.82%) emerges as the primary reason behind choosing certain metaphors, reflecting participants' high regard for ChatGPT's ability to rapidly deliver comprehensive knowledge. Time-Saving / Practical Utility (25.00%) underscores teacher candidates' recognition of ChatGPT as an efficient tool for course-related tasks. Conversely, Reliability & Transparency Concerns (18.18%) highlight anxiety about potential errors, unknown data sources, and AI algorithms' opacity (Bender et al., 2021). Tech Enthusiasm / High Expectations (13.64%) signals an optimistic outlook, though these sky-high expectations may lead to disappointment if not balanced by a realistic understanding of ChatGPT's limitations. Ethical Issues & Plagiarism (6.82%) touches on teacher candidates' fears that students might misuse ChatGPT, particularly regarding academic honesty and creative thinking. Lastly, Other (4.54%) indicates a smaller group perceiving ChatGPT as "mechanical" or "limited," emphasizing differences between AI-mediated and human-human interactions.

Positive, Negative, and Neutral Attitudes

Addressing the third research question, this segment explores the distribution of teacher candidates' metaphorical expressions according to positive, negative, and neutral attitudes toward ChatGPT. Table 3 shows the frequency and percentage of each category, along with quotations exemplifying such viewpoints.

Table 3. Distribution of Metaphorical Perceptions as Positive, Negative or Neutral

Attitude Category	Descriptors / Expressions	Frequency (n)	Percentage (%)	Sample Quotation (TC Codes)
Positive	Magic wand, knowledge storehouse, guide, assistant	110	50.00	"ChatGPT is basically a treasure trove of information; I save a lot of time looking for lesson materials." (TC47)
Negative	Black box, uncontrollable, unreliable, ethical worries	70	31.82	"I'm uneasy about false or source-unknown information, so I view it as a black box." (TC103)
Neutral	Balancing benefits and risks, conditional use, limited exposure	40	18.18	"I occasionally use ChatGPT; it's helpful but I'm not fully convinced, so I approach it cautiously." (TC19)
Total	-	220	100.00	-

Half of the participants hold positive perceptions, describing ChatGPT as a "guide," "treasure trove," or "assistant." About one-third convey negative views, underscoring "black box,"

"unknown," or "unreliable" aspects, often related to the system's opaque processes. The remaining neutral group frames ChatGPT as potentially beneficial yet advises caution due to perceived limitations. This distribution points to a broad range of attitudes among teacher candidates—some highly enthusiastic about the tool's advantages, others wary of ethical and transparency issues, and a moderate contingent seeking middle ground.

Influence of Demographic Variables:

Department and Familiarity with Technology

The fourth research question centers on how demographic factors—particularly academic

department and familiarity with technology—affect metaphorical perceptions of ChatGPT. Table 4 summarizes the dominant metaphors and sample statements for each demographic subgroup.

Tablo 4. Distribution of Metaphorical Perceptions by Academic Major and Technology Familiarity

Demographic Variable	Dominant Metaphor Themes	Frequency (n)	Sample Quotation (TC Codes)
Department (Primary Ed.)	Knowledge Repository, Assistant/Guide	40	"ChatGPT helps me develop various class activities, acting like a guide." (TC28)
Department (English Ed.)	Knowledge Repository, Magic Wand/Miracle	35	"For translation and reading materials, ChatGPT is like a magic wand—fast and practical." (TC74)
Department (Math Ed.)	Assistant/Guide, Black Box/Unfathomable Power	30	"It's great for formulas and example problems, but I worry when I don't know where the answers come from." (TC119)
Department (Other Branches)	Knowledge Repository, Assistant/Guide, Black Box (mixed)	45	"ChatGPT is multipurpose, but I still cross-check with different sources." (TC175)
High Tech Familiarity	Magic Wand/Miracle, Assistant/Guide	40	"I've used digital tools for a long time, and ChatGPT really feels like a magic wand." (TC33)
Moderate Tech Familiarity	Knowledge Repository, Assistant/Guide	20	"I ask it basic questions, and it quickly provides summary info—quite handy." (TC52)
Low Tech Familiarity	Black Box/Unfathomable Power, Neutral/Uncertain Perspective	10	"I'm not very tech-savvy; ChatGPT sometimes gives confusing answers, so I don't fully trust it." (TC201)
Total	-	220	-

Primary Education majors favor "Knowledge Repository" and "Assistant/Guide," while English Education majors add "Magic Wand/Miracle" to "Knowledge Repository," suggesting a more optimistic stance. Mathematics Education students emphasize "Assistant/Guide" yet also note "Black Box/Unfathomable Power," indicating caution over ChatGPT's reliability. In "Other Branches," a more blended approach emerges, although "Knowledge Repository" and "Assistant/Guide" remain prevalent. Examining technology familiarity reveals that teacher candidates with high familiarity tend toward "Magic Wand/Miracle" metaphors. Those with a moderate level mainly adopt "Knowledge Repository" or "Assistant/Guide," and those with low familiarity often reference "Black Box/Unfathomable Power" or hold generally neutral views, mentioning limited understanding of how ChatGPT functions or doubting the credibility of its outputs. Altogether, these findings affirm that departmental context and technological proficiency shape teacher candidates' metaphorical perceptions of ChatGPT in meaningful ways.

Conclusion and Discussion

This study investigated teacher candidates' metaphorical perceptions of ChatGPT, shedding light

on how AI-based language models are currently perceived and potentially integrated in the educational sector. The findings indicate that while candidates predominantly embrace ChatGPT as a "Knowledge Repository" or "Assistant/Guide," they also harbor considerable reservations, captured by metaphors like "Black Box/Unfathomable Power." Thus, although teacher candidates demonstrate robust interest and curiosity, they face lingering doubts about credibility and correctness.

Positive metaphors largely emphasize "fast information access," "time savings," and "ease in lesson planning." Yet negative or cautious outlooks highlight "ethical concerns," "lack of transparency," and "unclear data sources." These dual attitudes underscore that merely offering advanced technological tools is insufficient; the process must also address pedagogical and ethical frameworks. Particularly noteworthy is how teacher candidates who portrayed ChatGPT as a "magic wand" appear to expect transformative outcomes in teaching. However, such high expectations might, if poorly managed, lead to disappointment (Davis, 1989).

Overall, the research demonstrates that teacher candidates interpret ChatGPT in diverse ways and that their attitudes hinge on academic major and technological literacy. These findings underscore the need to strengthen AI literacy in teacher education programs, ensuring that prospective educators gain both technical competency and ethical awareness. Hence, fostering the informed, critical, and responsible use of AI-based technologies becomes a strategic target for teacher education and educational technology policies.

Metaphorical Diversity and Teacher Candidates' Readiness for Technology

Research findings indicate a notable diversity in the metaphors teacher candidates use to describe ChatGPT. This diversity stems not only from candidates' personal experiences and disciplinary requirements but also from their varying degrees of technological readiness and motivation (Lu, Liu, & Wang, 2023). In particular, the themes of "knowledge repository" and "assistant" reflect a need for rapid and multifaceted access to information through ChatGPT (Holstein, Aleven, & Rummel, 2023). Conversely, the presence of metaphors such as "black box" suggests that concerns about using this technology have yet to be fully alleviated (Bender et al., 2021).

Hence, teacher candidates' preparedness for technology extends beyond purely technical abilities. Rather, they also require critical thinking, ethical awareness, and pedagogical adaptation skills regarding AI tools like ChatGPT (Kim & Lee, 2023). The absence of coursework on AI and big data in teacher education programs may lead candidates toward indecision or excessive optimism when selecting their metaphors. Consequently, "metaphorical diversity" may simultaneously mask candidates' gaps in experience and knowledge. In this sense, understanding the perceptions behind these metaphors can provide valuable guidance for designing more comprehensive and up-to-date teacher education curricula (Russell & Norvig, 2010).

Rationales Behind Metaphors: Trust and Ethical Concerns Versus Speed and Variety

Data collected in this study indicate that teacher candidates cite factors such as "time-saving," "swift access to information," and "the provision of diverse content" as positive justifications for using ChatGPT. This finding suggests that practicality and functionality figure prominently among teacher candidates' expectations of technological tools in the teaching-learning process (Chang & Fang, 2023). For instance, the idea of quickly retrieving sample questions or materials during lesson planning significantly boosts candidates' interest in ChatGPT (Wang & Huang, 2021). In this regard, Davis's (1989) concept of "perceived usefulness" appears to exert a strong influence.

On the other hand, negative or cautious rationales focusing on "reliability" and "ethical issues" reveal that candidates adopt a critical stance toward this technology (Luckin, 2018). The possibility that ChatGPT might generate incorrect or conflicting information, omit proper source attribution, or leave unclear the origin of its responses contributes to its perception as a "black box" or "unfathomable power" (Bender et al., 2021). Furthermore, concerns around plagiarism, loss of originality, and copyright infringement prompt teacher candidates to approach ChatGPT with caution in classroom settings (Miao et al., 2023). Consequently, it may be argued that teacher education programs should explicitly address AI literacy, fact-checking, and ethical standards (Kim & Lee, 2023).

Distribution of Positive, Negative, and Neutral Attitudes: A Dual Perspective on AI

Half of the participants display positive attitudes toward ChatGPT, one-third adopt negative attitudes, and the remaining participants remain neutral. This distribution points to a multifaceted adoption process of AI tools in education (Mueller & Strohm, 2022). On the one hand, it reflects the excitement surrounding the high potential of AI technologies; on the other hand, it reveals uncertainty tied to unresolved ethical and technical issues (Ai & Chen, 2023). Consequently, while the majority view ChatGPT as a tool offering practical benefits to the teaching profession, a considerable segment remains cautious due to perceived risks and ambiguities.

This finding underscores that the digital transformation of education is not merely a matter of infrastructure or technological resources; it also involves teacher candidates' beliefs, attitudes, and value systems (Miao et al., 2023). Similarly, Selwyn (2019) discusses the societal and ethical dimensions of

AI in education as integral to whether these technologies are adopted or rejected. It follows that teacher candidates who maintain neutral positions might be guided toward a more constructive stance on AI through appropriate educational policies and awareness-raising initiatives (Henrickson, 2023).

Effect of Demographic Differences: Academic Major and Technological Familiarity

Differences in academic major and technological familiarity have emerged as significant variables influencing perceptions of ChatGPT. For instance, candidates in English or Primary Teacher Education programs are more inclined to adopt "knowledge repository" and "magic wand" themes, whereas Mathematics teacher candidates frequently employ the "black box" metaphor, expressing skepticism regarding reliability (He & Chen, 2023). These divergences may stem from the specific pedagogical and curricular needs of each discipline, as well as the technology culture within each faculty (Koehler & Mishra, 2009).

Additionally, teacher candidates possessing high technological proficiency tend to extol ChatGPT with stronger metaphors such as "magic wand," whereas those with limited technological experience exhibit greater caution and concern (Zhai, 2022). This observation underscores that the success of AI integration largely depends on teacher candidates' technological competencies and digital literacy levels (Chang & Fang, 2023). Accordingly, universities and policy makers should implement multifaceted instructional designs tailored to distinct majors and varying degrees of prior experience (Kim & Lee, 2023). With carefully crafted strategies for each field and competency level, prospective teachers can learn to use ChatGPT and similar tools both responsibly and effectively.

Suggestions

1. This study utilized metaphor analysis. Future research could employ mixed-method designs that integrate quantitative approaches (e.g., technology acceptance models, AI attitude surveys) with qualitative methods to provide a more comprehensive understanding.
2. Experimental studies with teacher candidates from different disciplines could be conducted to concretely measure the impact of ChatGPT on lesson planning, instructional material development, and assessment processes.
3. Comparative studies examining teacher candidates' metaphorical perceptions of ChatGPT across various universities, regions, and countries would help elucidate how cultural and institutional factors shape attitudes toward technology.
4. Given the clear concerns regarding ethics and reliability among teacher candidates, further research should systematically explore strategies to mitigate risks associated with AI tools, such as misuse (e.g., plagiarism, issues of originality) and the propagation of bias.

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Prospective Elementary Mathematics Teachers' Views on the Use of Islamic Geometric Patterns in Mathematics Lessons

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Abstract

This study aims to examine the views of prospective elementary mathematics teachers regarding the use of Islamic Geometric Patterns (IGPs) in mathematics lessons. Conducted within a qualitative research design, the study collected data from seven teacher candidates—third-year students who had taken an elective course on IGPs—through a semi-structured interview form. The data were analyzed using content analysis, and a descriptive approach was adopted to interpret the findings based on themes, categories, and codes. The analysis revealed that the experiences and opinions of the teacher candidates about the use of IGPs were grouped under seven main themes: "Interest and Attitude Towards Mathematics," "Establishing Interdisciplinary Context," "Creativity and Instructional Design Skills," "Visualization and the Concretization of Geometric Concepts," "Integrating Historical and Cultural Context into Teaching," "Limitations and Challenges," and "Suggestions for Effective Utilization." The findings indicate that IGPs can contribute to developing positive attitudes toward mathematics, fostering interdisciplinary integration, supporting creativity and instructional design skills, facilitating the understanding of geometric concepts, and providing a cultural-historical perspective. However, issues such as time management, topic alignment, and material shortages may prevent smooth implementation in every context. The study highlights that IGPs can serve as a potential tool for enriching mathematics teaching, enhancing students' motivation and comprehension levels, and encourages the development of guiding resources, technological support, collaborative activities, and practical applications to realize this potential.

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Introduction

One of the main objectives of mathematics education is to enable students to make sense of abstract concepts, develop geometric thinking skills, and cultivate a positive attitude toward mathematics (Ward, 2003; Rumanová & Smiešková, 2015). In this regard, instead of merely transmitting theoretical information, a learning-teaching process enriched with cultural, artistic, and historical elements can provide students with a meaningful mathematical experience (Verner, Massarwe & Bshouty, 2013; Zuliana, Dwiningrum, Wijaya & Purnomo, 2023). Particularly in the field of geometry, the importance of aesthetic and cultural motifs for creating real-life connections, establishing interdisciplinary contexts, and strengthening visual-spatial thinking skills is becoming increasingly evident (Chang, 2018; Hemmerling, 2019; Karadağ & Akar, 2020).

Ornamentation refers to covering surfaces or structures with one or more geometric shapes, without gaps or overlaps (Aktaş, Ercan & Bulut, 2024; Britton & Seymor, 1989, as cited in Aktaş et al., 2015). Throughout history, ornamentation has found correspondences in various fields such as architecture (Takva & Takva, 2023; Takva, Takva & Takva, 2023), engineering (Kizilörenli & Maden, 2021), art (Webb, 2019), ethnomathematics (Verner et al., 2019; Zuliana et al., 2023), education (Aydin-Güç & Hacisalihoglu-Karadeniz, 2020; Ovadiya, 2019), technology (Laksmiwati et al., 2023), and handicrafts (Karadağ & Akar, 2020; İpek & Özmüş, 2014). In Islamic architecture, Islamic Geometric Patterns (IGPs)—which appear on pulpits (minbar), prayer niches (mihrab), columns, and wall coverings with regular or semi-regular patterns—stand out for their use of polygons such as squares, hexagons, and octagons, formed through various applications of transformational geometry (reflection, translation, rotation) (Aktaş et al., 2015; Eryılmaz & Selimgil, 2021).

These Patterns in Islamic architecture are essentially concrete manifestations of mathematical principles in space (Takva & Takva, 2023; Bush, 2021; Eryılmaz & Selimgil, 2021). In examples such as Beyşehir Eşrefoğlu Mosque, Sivrihisar Ulu Mosque, and Konya Alâeddin Mosque in Turkey, the patterns on pulpits and mihrabs demonstrate the effectiveness of geometry in architectural production and reveal how mathematical relations intertwine with cultural-historical contexts (Takva & Takva, 2023). Similarly, patterns produced using various materials, such as stone, wood, and tiles in places like Iran, Morocco, India, Spain, Egypt, and Uzbekistan, reflect the mathematical heritage of Islamic culture (Eryılmaz & Selimgil, 2021; Kılıçoğlu & Pilehvarian, 2017).

In educational contexts, such Patterns offer opportunities for students to recognize polygons, discover types of symmetry, and make sense of the concepts of transformation geometry (reflection, rotation, translation) (Ward, 2003; Callingham, 2004). Through this process, students associate abstract concepts with cultural heritage and aesthetic elements, thus experiencing a more meaningful learning environment (Rumanová & Smiešková, 2015; Verner et al., 2013; Webb, 2019). The literature shows that this approach increases student motivation (Laksmiwati et al., 2023), supports creative problem-solving skills (Ilucová, 2004; Ovadiya, 2019), encourages the meaningful use of technology (Ward, 2003; Laksmiwati et al., 2023), and offers an ethnomathematical perspective (Zuliana et al., 2023; Verner et al., 2019).

For prospective teachers, this approach has the potential to enhance professional competencies, innovative material development skills, and cultural sensitivity (Capone et al., 2024; Hemmerling, 2019). In line with the ethnomathematical approach, prospective teachers can bring activities into the classroom that make mathematics meaningful by considering students' cultural experiences (Verner et al., 2013; Verner et al., 2019). Thus, mathematics education provides a richer learning experience at the intersection of cultural heritage, art, architecture, and technology (Karadağ & Akar, 2020; İpek & Özmüş, 2014).

Ornament-based activities not only enable students to understand concepts such as transformation geometry, symmetry, proportion, and pattern but also create opportunities to develop manual skills, use technological tools, foster collaborative learning, and build cultural awareness (Chang, 2018; Aktaş, Ercan & Bulut, 2024; Yamamoto, Nakazato & Mitani, 2022). Examples such as Anatolian ornamentations and

Islamic geometric designs help students relate mathematical content to cultural elements they might encounter in daily life (İpek & Özmüş, 2014; Eryılmaz & Selimgil, 2021; Bush, 2021).

At this point, although studies on using ornamentation in education are increasing in the literature (Tekin, 2024), there is a need for systematic research examining the views of prospective teachers specifically in the context of Islamic Geometric Patterns. Further research is required on how IGPs can be used in elementary mathematics lessons, and their effects on students' attitudes, conceptual understanding levels, and cultural awareness (Karadağ & Akar, 2020; Verner et al., 2019; Zuliana et al., 2023).

This study aims to fill this gap in mathematics education literature by determining prospective teachers' experiences, attitudes, and perceptions regarding the use of IGPs in mathematics lessons. The findings may guide teacher training programs, material development processes, curriculum design, the effective use of technology, and the adaptation of ethnomathematics-based activities to the classroom context. Thus, it is expected to contribute to adopting a holistic teaching approach that highlights the cultural, aesthetic, and interdisciplinary dimensions of mathematics education.

The main purpose of this research is to reveal the experiences, attitudes, and perceptions of prospective teachers regarding the use of IGPs in elementary mathematics teaching. In this way, the potential contributions of ornament-based activities to student motivation, conceptual understanding, relating cultural heritage, creative thinking, and developing interdisciplinary contexts will be evaluated. The results are expected to emphasize the importance of teaching approaches that consider the cultural, aesthetic, and creative dimensions of mathematics education and enrich the literature.

Method

This study is a basic qualitative inquiry conducted within a qualitative research framework (Creswell, 2013; Merriam & Tisdell, 2015). The data were thematically structured through content analysis, enabling an in-depth examination of participants' subjective perceptions, experiences, and thoughts (Braun & Clarke, 2006; Miles, Huberman & Saldaña, 2014).

Participants

The participants of the study consist of seven prospective teachers in their third year of a university's elementary mathematics teacher education program who voluntarily chose an elective course on IGPs. These participants, who formed the primary data source of the research, reflected on their experiences gained during the IGO course.

Data Collection Tool and Procedure

Data were collected through a semi-structured interview form. This form contained open-ended questions focused on the integration of IGPs into mathematics lessons, their possible contributions to mathematical thinking skills, teaching materials, the establishment of interdisciplinary contexts, lesson planning experiences, and suggestions for practice. Participants provided written responses, allowing them to express their experiences in detail. Anonymity and confidentiality were carefully observed.

Data Analysis

The collected data were analyzed through content analysis. First, the data were read holistically, and then meaningful expressions were coded. Similar codes were merged to form sub-categories, categories, and themes (Braun & Clarke, 2006). Multiple researchers independently coded the data to ensure reliability, and discrepancies were discussed until a consensus was reached. The themes allowed a comprehensive and systematic presentation of the findings.

Findings

As a result of the content analysis, the views of prospective teachers on the use of Islamic Geometric Patterns (IGPs) in mathematics lessons were gathered under seven main themes. These themes are the product of a holistic understanding of the data and reflect participants' perceptions and experiences across a broad spectrum, from attitudes toward the lesson to interdisciplinary connections, from creativity and instructional design skills to the concretization of geometric concepts,

historical-cultural dimensions, challenges encountered in practice, and suggestions for more effective use. Below, we first present the related categories and codes under each theme, followed by a detailed discussion of how these themes materialized through participant statements, thereby providing the reader with a detailed, systematic, and comprehensive account of the findings.

Theme 1: Interest and Attitude Towards Mathematics

Two key categories stand out in this theme: (1) Making Mathematics Enjoyable and (2) Increased Motivation. These categories are substantiated by codes such as "developing a positive attitude," "increased interest in the lesson," "arousing curiosity," and "fun learning environment."

Participants' statements indicate that IGPs can make abstract mathematical concepts more appealing, leading students to adopt a more positive attitude toward the lesson. For instance, one participant stated, "...this can prevent students' negative attitudes toward mathematics" (P1), emphasizing that IGO-based activities could break preconceptions. Another participant mentioned, "Islamic geometric Patterns made the topic more interesting" (P4), pointing out that IGPs transform mathematics lessons into environments that grab and pique students' curiosity. Similarly, "Experiencing mathematics in a concrete context can strengthen positive attitudes" (P2) underscores that presenting mathematics—often filled with abstract concepts—in concrete examples can bolster students' motivation. Another participant added, "It becomes easier to capture the attention of that age group, and it can be shown that math is not a subject to be feared" (P7), highlighting how IGPs can foster positive emotions toward mathematics.

Theme 2: Establishing Interdisciplinary Context

Two categories emerged here: (1) Integration with Other Courses and (2) Multi-Dimensional Learning Experience. Under these categories, codes such as "connecting with religious education and ethics," "integration with social studies," "integration with visual arts," and "relating to real life" show that mathematics can merge with various disciplines, creating meaningful learning opportunities.

One participant said, "A learning experience that blends religious culture and ethics, social studies, and visual arts can be offered" (P1), noting that IGPs provide a means to move mathematics beyond just numbers and operations, allowing for a broader contextual examination. Another participant remarked, "Teaching the history of a mosque in social studies and its ornamentation in mathematics makes a lot of sense" (P5), emphasizing that mathematics offers an analytic framework for students to interpret culturally and historically shaped spaces. Other comments included, "This demonstrates that mathematics is not just about numbers but is connected to all subjects" (P7) and "Establishing interdisciplinary connections also contributes to students' multi-faceted thinking" (P3). These views indicate how IGPs help students discover different modes of thought and regard mathematics as a discipline situated in everyday life, art, history, and culture.

Theme 3: Creativity and Instructional Design Skills

In this theme, categories such as Activity Development and Material Design and Creativity and Patience Development stand out, with relevant codes including "lesson plan preparation," "variety of activities," "manual skills," and "a process requiring patience." The statements of teacher candidates suggest that IGPs enrich instructional design processes and encourage creativity.

For example, one participant noted, "I realized I had to pay attention to every detail when preparing the lesson plan" (P1), implying that IGPs require a more meticulous approach to lesson design. "I think I can develop various activities" (P2) indicates that IGPs inspire prospective teachers to create innovative learning experiences. Moreover, "Drawing and coloring enhanced my creativity" (P4) points out how activities requiring aesthetic and manual skills can also stimulate creativity alongside professional skills. Another participant added, "It was a course that required patience and should be voluntary" (P7), emphasizing that this process further cultivated the patience and dedication of teacher

candidates. Thus, IGPs serve as a laboratory that strengthens prospective teachers' pedagogical and artistic abilities.

Theme 4: Visualization and the Concretization of Geometric Concepts

Two categories emerge here: Recognition and Classification of Geometric Shapes and Patterns and Symmetry. Codes such as "polygons," "classification by the number of edges," "repetitive patterns," and "translation and reflection" highlight how IGPs reinforce geometry topics with concrete examples.

Participants stated, "It can be used in teaching polygons; they can be classified by the number of sides" (P3), emphasizing how IGPs make abstract geometric concepts more tangible. Another participant mentioned, "In discussing patterns, one can question at what intervals certain shapes repeat" (P4), drawing attention to the mathematical structure of designs. "Teaching symmetry through designs could make it easier for students to understand" (P6) argues that visual arrangements leave more lasting impressions on students' minds. Additionally, "Presenting abstract mathematical concepts in a visual and concrete manner strengthens problem-solving skills" (P2) and "Classifying geometric shapes based on coloring or drawing provides more meaningful and lasting learning" (P1) illustrate how IGPs support students' problem-solving and analytical skills through visual methods.

Theme 5: Integrating Historical and Cultural Context into Teaching

Cultural Awareness and the Universal Nature of Mathematics stand out as categories under this theme. Codes such as "historical sites" and "connection with cultural heritage" suggest that mathematics is not merely an abstract discipline but one that holds a specific historical and cultural background.

Teacher candidates note, "Now I examine Patterns I see; I look at my surroundings with different eyes" (P7), indicating that IGPs allow students to read the geometric patterns they encounter in daily life through a cultural-historical lens. Another participant stated, "It showed that mathematics can be integrated into any field" (P2), pointing to the universality of mathematics. Also, "It's very logical to teach the mosque or tomb in religious education, its history in social studies, and its structure in mathematics" (P5) suggests that this historical and cultural context can transform lessons from isolated segments into an interdisciplinary and holistic learning experience.

Theme 6: Limitations and Challenges

The categories of Time Management Issues and Limited Integration Opportunities indicate that implementing IGPs is not always seamless, as reflected by codes such as "time-consuming" and "limited applicability to certain topics."

One participant admitted, "It took a lot of time and was challenging" (P7), implying that planning IGO activities demands meticulous work. "Time constraints can arise, so practice is needed" (P3) similarly stresses the need for effective time management. Some participants noted, "I think the scope of the lesson is not that broad; the mathematical theme that can be integrated is limited" (P1), suggesting that not all topics are suitable for IGPs. "I think it can be tackled for just one theme at most" (P5) also points to a narrowing scope. Additionally, "Procuring materials was initially challenging" (P4) highlights how material shortages could negatively impact the process.

Theme 7: Suggestions for Effective Utilization

This final theme focuses on Resource and Material Support and Hands-On and Collaborative Learning, presenting codes such as "creating a guidebook," "use of technology," "collaborative learning," and "real-life connections."

Participants noted, "Publishing books or magazines tailored to this area would clarify teachers' paths" (P1), emphasizing the importance of reference materials. "Students can develop their creativity by creating their own designs" (P2) points to the necessity of practical, student-centered activities, while "Making puzzle-like cutouts or increasing hands-on activities could be more fun, meaningful, and effective" (P6) highlights the potential for more engaging practices. In

addition, "Active use of technological tools and connecting lessons to real life is important" (P2) underlines how IGPs can be integrated with contemporary educational technologies and supported with examples closely related to students' lives.

Conclusion And Discussion

This study examined the views of prospective teachers on the use of IGPs in mathematics lessons, revealing that Patterns can contribute to a broad range of outcomes, from understanding mathematical concepts to developing cultural awareness. In line with the literature, the findings show that Patterns can enhance students' attitudes toward mathematics (Ward, 2003; Webb, 2019), facilitate the concretization of abstract topics like transformational geometry, symmetry, and polygon properties (Callingham, 2004; Rumanová & Smiešková, 2015), and offer opportunities for interdisciplinary learning (Verner et al., 2013; Zuliana et al., 2023; Karadağ & Akar, 2020).

Prospective teachers' emphasis on how IGPs can increase student motivation, foster aesthetic sensibility, and bolster creativity and material development skills aligns with existing findings about the educational potential of ornamentation (Hemmerling, 2019; Ovadiya, 2019). Moreover, it is understood that using technological tools in ornament-based activities can offer an exploratory learning environment (Chang, 2018; Laksmiwati et al., 2023; Yamamoto et al., 2022), integrating a cultural perspective into mathematics learning through an ethnomathematical approach (Verner et al., 2019; Zuliana et al., 2023).

However, the research findings also show that challenges such as time management, topic alignment, and material shortages can hinder the use of Patterns in practice. Similar limitations are highlighted in the literature, suggesting that prospective teachers overcome these barriers by utilizing guide materials, professional development programs, technology-supported activities, and collaborative study methods (Capone et al., 2024; Tekin, 2024).

Limitations And Recommendations

This study was conducted with a limited number of prospective teachers. Future research involving more diverse participants from different cultural and academic backgrounds could enhance the generalizability of the findings. Additionally, rather than focusing solely on prospective teachers' views, classroom observations, analyses of student work, and long-term impact assessments could be employed to gain a more comprehensive understanding of how ornament-based activities influence the teaching process.

In subsequent studies, the use of software such as GeoGebra and TbMT in ornament activities could be explored, supporting prospective teachers' technological literacy, creative material development, and student-centered approaches to discovering geometric concepts. By incorporating courses on planning and implementing ornament-based activities into teacher training programs, both the mathematical and cultural capital of prospective teachers could be enriched. Investigating ornamentations from various cultural heritages could also help students appreciate that mathematics is a universal language.

In summary, this study emphasizes the value that IGPs can add to mathematics education in terms of aesthetics, culture, and interdisciplinarity. By adopting this approach, prospective teachers can contribute to students experiencing mathematics as a more meaningful, engaging, culturally enriched, and creative field of activity. In this regard, the diversification of ornament-based activities, their integration with technology, incorporation into teacher training programs, and long-term impact assessments will provide opportunities to enrich mathematics education with an innovative and holistic perspective.

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