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### Determination of Artificial Intelligence Literacy Levels of German Language Teacher Candidates Almanca Öğretmeni Adaylarının Yapay Zeka Okuryazarlık Düzeylerinin Belirlenmesi

Rahim ŞENTÜRK<sup>1</sup> 

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**Abstract:** In recent years, artificial Intelligence (AI) technologies have had a significant impact on many areas, including education. Foreign language teaching, in particular, is undergoing rapid change and transformation with the spread of AI tools such as ChatGPT, Gemini, and Bing. In order for these technologies to be used effectively and correctly, individuals must have sufficient AI literacy. This study aims to determine the AI literacy levels of German teacher candidates and to examine these levels in terms of variables such as gender, age, and class level. The research was conducted with a sample of 75 German teacher candidates from the 1st, 2nd, 3rd, and 4th grades at Trakya University. A comparative descriptive survey model was used as a quantitative method. Data were collected using the "Artificial Intelligence Literacy Scale" adapted into Turkish by Polatgil and Güler (2023) and analyzed using the SPSS program. The findings offer multiple contributions in terms of AI integration in teacher education programs, digital material development, and sustainable pedagogical purposefulness.

**Keywords:** Artificial Intelligence, AI Literacy, Prospective German Teachers, Foreign Language Education

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**Öz:** Yapay Zekâ (YZ) teknolojileri son yıllarda eğitim dâhil birçok alanda önemli etkiler yaratmıştır. Özellikle yabancı dil öğretimi, ChatGPT, Gemini ve Bing gibi YZ araçlarının yaygınlaşmasıyla hızlı değişim ve dönüşüme uğramaktadır. Bu teknolojilerin etkili ve doğru biçimde kullanılabilmesi için bireylerin YZ okuryazarlık düzeylerinin yeterli olması gerekmektedir. Bu çalışma, Almanca öğretmen adaylarının YZ okuryazarlık düzeylerini belirlemeyi ve bu düzeyleri cinsiyet, yaş, sınıf düzeyi gibi değişkenler açısından incelemeyi amaçlamaktadır. Araştırma, Trakya Üniversitesi öğrenim gören 1., 2., 3. ve 4. sınıf Almanca öğretmen adaylarından oluşan 75 kişilik bir örnekleme yürütülmüştür. Nicel bir yöntem olarak karşılaştırmalı betimsel tarama modeli kullanılmıştır. Veriler, Polatgil ve Güler (2023) tarafından Türkçeye uyarlanan "Yapay Zekâ Okuryazarlığı Ölçeği" ile toplanmış ve SPSS programı aracılığıyla analiz edilmiştir. Bulgular, öğretmen eğitimi programlarında YZ'nin entegrasyonu, dijital materyal geliştirme ve sürdürülebilir pedagojik amaçlılık açısından çoklu katkılar sunmaktadır.

**Anahtar Kelimeler:** Yapay Zekâ, YZ Okuryazarlığı, Almanca Öğretmen Adayları, Yabancı Dil Eğitimi

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<sup>1</sup> Sorumlu Yazar: Araş. Gör. Dr. Rahim Şentürk, Trakya Üniversitesi, Yabancı Diller Eğitimi Bölümü Alman Dili Eğitimi, rahimsenturk@trakya.edu.tr, 0000-0002-3053-6784

## 1. Introduction

The 21st century is marked by unprecedented technological advancements, greater accessibility to information, and an intensifying process of globalization. These rapid transformations necessitate innovative skills and approaches within education systems, particularly among educators who are expected to guide future generations. Artificial intelligence (AI) and its burgeoning applications represent a pivotal development in human history, influencing nearly every discipline. “In the realm of education, and specifically within teacher education, AI has emerged as a transformative force” (Şentürk, 2023: 409).

This paradigm shift underscores the imperative for foreign language teacher candidates to adapt to rapid technological changes. Their ability to integrate AI-driven tools and methodologies will be instrumental in shaping the future of language education. The advent of AI has brought concepts such as individualized learning, personalized feedback, and customized education to the forefront (Singh and Ram, 2024). Consequently, it is essential to incorporate AI-focused training and applied coursework into undergraduate teacher education programs.

As AI continues to evolve, it offers unparalleled opportunities to redefine teacher preparation, equip educators with the competencies required for an AI-driven educational landscape, and enhance the overall quality of learning experiences (Singh and Ram, 2024; Seif Eldin, 2024). Such developments call for a proactive and visionary approach to teacher education, ensuring that educators are not only responsive to technological advancements but also actively leverage them to foster enriched, learner-centered environments.

Recent research highlights the growing importance of AI literacy in teacher education. AI literacy encompasses the essential knowledge, skills, and ethical awareness required to effectively and responsibly utilize AI tools in educational settings (Rütti-Joy et al., 2023; Vazhayil et al., 2019). This competence is pivotal for sustainable teacher training and ethical AI integration in schools. However, current studies reveal that AI literacy remains an emerging topic, with significant gaps in addressing the practical and ethical dimensions of AI use in education (Sperling et al., 2024).

While research in English teacher education has made notable progress in integrating AI literacy, there remains a paucity of studies focusing on German language teachers (Şentürk & Göktaş, 2024). This gap underscores the urgency of expanding research efforts in this field, particularly to equip German language educators with the necessary skills to harness AI technologies effectively. Addressing these gaps will not only advance teacher education but also enhance the broader educational landscape by fostering a generation of educators prepared for the challenges and opportunities of an AI-driven future.

### 1.1. Literature Review

Recent years have seen a growing interest in incorporating artificial intelligence (AI) into educational settings, especially regarding digital literacy and teacher training. Generally, AI literacy refers to an individual’s capacity to comprehend, critically assess, and efficiently utilize AI technology in both personal and professional contexts (Long & Magerko, 2020). In the field of teacher education, AI literacy is becoming a crucial skill, indicating the increasing necessity for educators to adjust to AI-based learning environments and incorporate intelligent technologies into their teaching methods (Zawacki-Richter et al., 2019).

Numerous studies have emphasized the importance of developing AI-related competencies among pre-service teachers (Holmes et al., 2022; Wang et al., 2023). These competencies include not only technical knowledge but also ethical awareness, critical thinking, and the pedagogical application of AI tools in the classroom. Research by Lee and Kim (2021) demonstrated that pre-service teachers with higher levels of AI literacy were more confident in adopting digital innovations and more likely to apply AI-supported teaching methods in language instruction.

In the specific context of foreign language education, studies have shown that AI tools—such as automated feedback systems, speech recognition technologies, and intelligent tutoring systems—can significantly

enhance language learning outcomes when effectively employed by trained educators (Lu et al., 2022). However, there remains a notable gap in AI-related training within teacher education programs, particularly for language teachers (Chiu et al., 2021).

Furthermore, empirical evidence indicates a disparity in AI literacy levels among teacher candidates, often shaped by factors such as prior digital experience, access to training, and institutional support (Celik & Yilmaz, 2022). This underscores the need for more structured curricular interventions and professional development programs to promote AI awareness and competence across diverse teaching disciplines.

Despite growing research interest, the majority of existing studies have focused on STEM fields, leaving AI literacy in language teacher education relatively underexplored. Therefore, investigating the current state of AI literacy among pre-service German language teachers, as well as the variables influencing it, is both timely and essential.

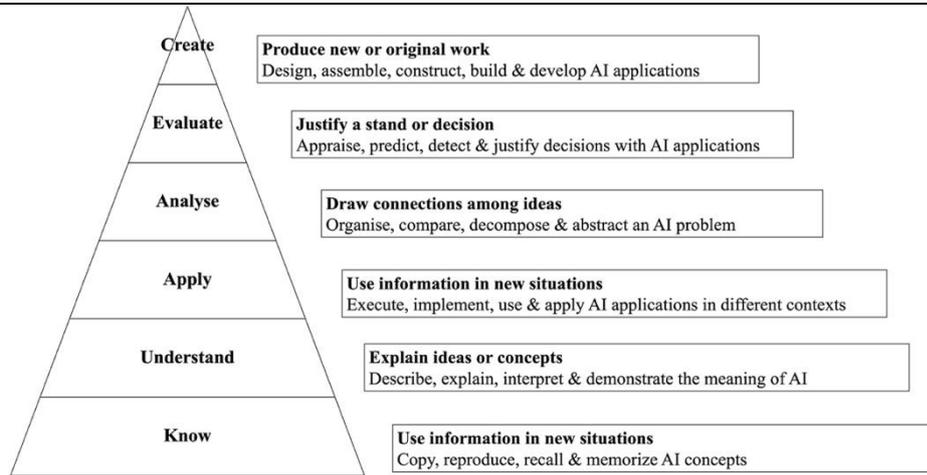
## 1.2. Artificial Intelligence Literacy

Artificial intelligence literacy encompasses a comprehensive framework that integrates diverse dimensions, including knowledge, skills, tools, attitudes, methodologies, and ethical considerations in the application of AI technologies (Çelebi et al., 2023). It has emerged as a critical domain within research and education, aiming to equip individuals with the necessary competencies to understand, evaluate, and ethically engage with AI technologies (Cuomo et al., 2022; Stolpe & Hallström, 2024; Ng et al., 2023). As Long and Magerko (2020) assert, AI literacy represents a set of competencies enabling individuals to critically assess AI systems, communicate effectively with AI tools, and integrate AI into various domains, such as online interactions, home environments, and professional settings. Similarly, Wang et al. (2023) define AI literacy as the awareness and practical understanding of AI technologies in real-world applications.

Research in this field has gained substantial momentum, with notable contributions from the United States, China, Spain, and Germany (Tenório et al., 2023). Emerging AI literacy frameworks highlight three key pillars: technological-scientific knowledge, socio-ethical awareness, and technical proficiency (Stolpe & Hallström, 2024). In secondary education, project-based collaborative learning is the most prevalent pedagogical approach, with curricula tailored to introduce foundational AI concepts to younger students while addressing more advanced topics for older learners (Ng et al., 2023; Laupichler et al., 2022).

To further enhance its relevance, the integration of AI literacy into broader technological literacy is proposed through a multiliteracy framework that accommodates the interdisciplinary nature of AI (Stolpe & Hallström, 2024). This framework addresses diverse areas of focus, including machine learning, big data, deep learning, and ethical considerations in AI development and usage (Tenório et al., 2023). These components not only underscore the importance of technical skills but also emphasize the need for ethical understanding, fostering a critical perspective on the societal implications of AI technologies.

AI literacy, as a multidisciplinary concept, is vital for preparing individuals to navigate an increasingly AI-driven world. Its integration into educational frameworks at all levels holds promise for developing future generations of responsible AI users and innovators, thereby contributing to sustainable technological and societal progress.



**Figure 1:** *The adapted Bloom's Taxonomy for Artificial Intelligence*

The adapted Bloom's Taxonomy for Artificial Intelligence (AI) literacy provides a hierarchical framework to understand and categorize the different levels of competencies described in the text (Ng, et al., 2021: 5). This visual illustrates how learners progress from foundational knowledge to higher-order cognitive skills, aligning with the multidimensional nature of AI literacy outlined by various researchers (Çelebi et al., 2023; Long & Magerko, 2020; Kong, Cheung, & Zhang, 2021).

- **Knowledge and Understanding:** At the base of the taxonomy, competencies such as recognizing and recalling AI concepts align with the "understanding" and "awareness" components of AI literacy (Wang et al., 2023). These levels address the foundational need for learners to describe and interpret AI principles and terminology.
- **Application:** The ability to use AI technologies in new and practical contexts connects to the "usage" dimension of AI literacy. This stage involves implementing AI tools effectively in both educational and professional environments, as highlighted in the text (Ng et al., 2023; Stolpe & Hallström, 2024).
- **Analysis and Evaluation:** The stages of "analyzing" and "evaluating" reflect the critical thinking skills emphasized in AI literacy. These levels involve comparing, appraising, and justifying decisions when working with AI technologies, particularly in ethical and socio-technical contexts (Cuomo et al., 2022).
- **Creation:** At the highest level, the taxonomy emphasizes creativity and innovation, enabling learners to design and construct new AI applications. This corresponds to the advanced competencies required for AI-driven problem-solving and collaborative projects mentioned in the text (Laupichler et al., 2022).

By connecting the visual to the text, Bloom's Taxonomy highlights how AI literacy spans from basic awareness and understanding to advanced skills like critical evaluation and creative application. This structured progression underscores the importance of integrating AI literacy into educational curricula to develop learners' cognitive and practical competencies in an increasingly AI-driven world.

### 1.3. Importance of the Study

As artificial intelligence (AI) technologies increasingly influence education, understanding students' abilities to engage with AI tools has become critical (Elcicek, 2024; Çelebi et al., 2023; Laupichler et al., 2022; Wulff et al., 2024). This study addresses an important gap by examining the AI literacy levels of German language teacher candidates, a key group in shaping future educational processes.

By exploring competencies such as understanding, using, and interacting with AI applications, the study aims to enhance teacher training programs, optimize foreign language teaching processes, and inform educational policies. Additionally, investigating the effects of demographic factors like age, gender, and grade level will contribute to the development of inclusive and effective teaching strategies. The findings are expected to provide valuable insights for curriculum design, promote the integration of AI in foreign language education, and prepare educators for emerging roles, such as AI educators, in a rapidly evolving digital landscape.

#### **1.4. Research Aim and Research Questions**

The primary aim of this research is to assess the artificial intelligence (AI) literacy levels of prospective teachers enrolled in the German Language Teaching Department at Trakya University. Additionally, it seeks to investigate whether these literacy levels vary significantly based on demographic factors, such as gender, age, and grade level.

##### Research Questions

- 1. What are the AI literacy levels of prospective German teachers?
- 2. Do the AI literacy levels of prospective German teachers differ significantly according to demographic variables?

## **2. Methodology**

This study employed a comparative descriptive survey design, a form of quantitative research used to identify and compare the characteristics of different groups based on a single dependent variable—in this case, artificial intelligence (AI) literacy. The model is particularly suitable for educational research where the primary goal is to determine the current state of a phenomenon and assess whether it differs significantly across demographic groups (Creswell & Creswell, 2018; Karasar, 2008).

Unlike correlational models, which focus on measuring the strength and direction of relationships between continuous variables, the comparative descriptive approach is designed to describe and analyze group differences based on categorical variables such as gender, age group, and academic level. In this study, no causal or predictive relationships were hypothesized; instead, statistical comparisons were made to identify whether AI literacy levels varied significantly among predefined demographic categories. Common techniques used in this model include t-tests and ANOVA, depending on the number of groups being compared (Fraenkel, Wallen, & Hyun, 2012; Johnson & Christensen, 2020).

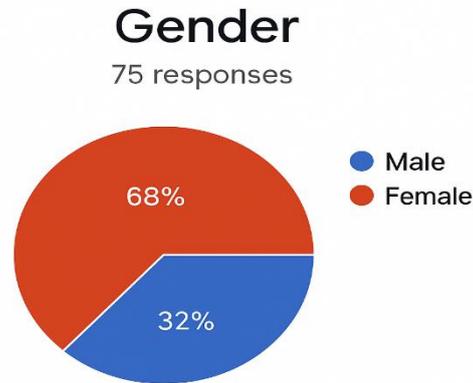
This design was chosen because it aligns directly with the study's research questions, which aim to (1) determine the AI literacy levels of pre-service German language teachers and (2) examine whether these levels differ according to demographic variables. Given the exploratory nature of this research and the relatively small sample size, the comparative descriptive model provided an appropriate framework for drawing valid, context-specific insights without implying causality.

### **2.1. Publication Ethics**

This study was conducted in accordance with the principles of research and publication ethics. Approval for the study was obtained from the Ethics Committee of Trakya University (Approval No: 2024/08, Date: 15.02.2024). All participants were informed about the purpose of the research and participated voluntarily.

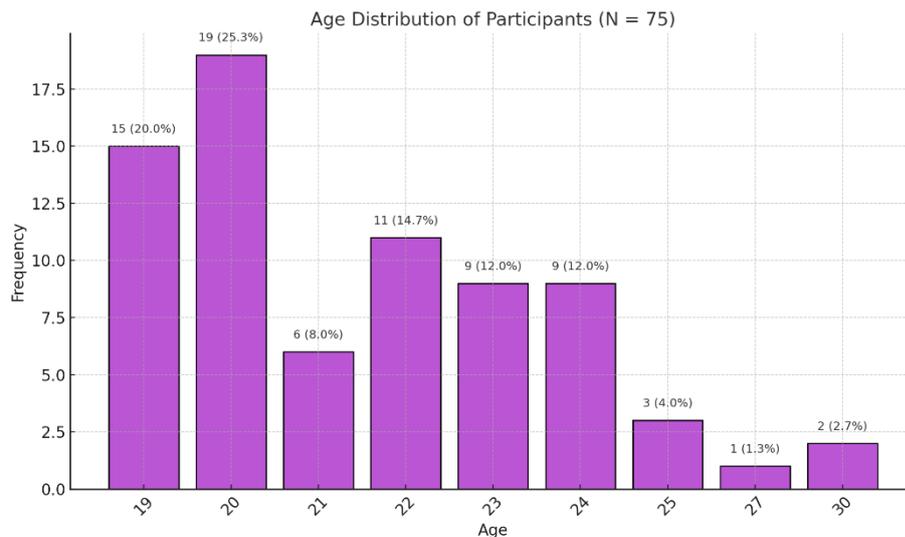
## 2.2. Participants

The sample of the study consists of German teacher candidates from Trakya University. The convenient sampling method was employed for sample selection. A total of 75 teacher candidates voluntarily participated in the study.



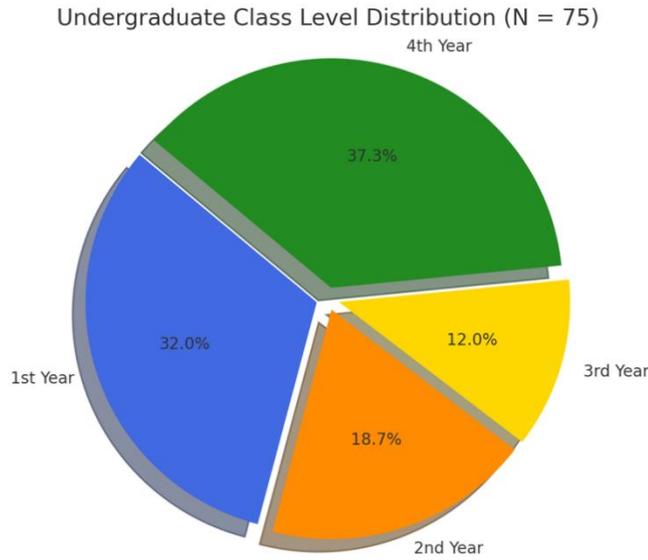
**Figure 2:** *Gender of Participants*

As shown in Figure 2, the gender distribution of the participants reveals that 68% are female (51 individuals), while 32% are male (24 individuals). Female participants represent the majority of the sample, indicating that the study's participant group is predominantly female.



**Figure 3:** *Age of Participants*

Figure 3 presents the age distribution of the participants. The data show that the majority of respondents are between the ages of 19 and 24. The most common age is 20, representing 25.3% of the sample (n = 19). There are no respondents older than 30, which indicates that the participant group predominantly consists of young adults.



**Figure 4:** *Participants' Undergraduate Level*

Figure 4 illustrates the distribution of participants according to their undergraduate class levels. The highest proportion of responses came from 4th-year students, accounting for 37.3% of the total. This was followed by 1st-year students at 32%, while 2nd-year and 3rd-year students represented 18.7% and 12%, respectively. These results reflect a relatively diverse yet balanced sample across academic levels.

### 2.3. Data Collection

This study utilized a survey divided into two main sections. The first section gathered basic demographic and contextual information, including gender, age, daily internet and social media usage, and digital device ownership. The second section consisted of the "Artificial Intelligence Literacy Scale," designed to assess the current AI literacy levels of German teacher candidates.

The Artificial Intelligence Literacy Scale was adapted into Turkish by Polatgil and Güler (2023) and specifically developed to measure skills related to artificial intelligence. Previous validity and reliability studies confirmed the scale as a reliable data collection tool. Participants completed the survey online via Forms. The data collection process adhered to ethical research guidelines, ensuring participant confidentiality and data protection throughout the study.

#### 2.3.1. Reliability and validity of the data collection tool

The data collection tool used in this study is the Artificial Intelligence Literacy Scale, adapted into Turkish by Polatgil and Güler (2023). The scale was designed to measure the AI literacy levels of adults and comprises 12 items structured on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). It evaluates four dimensions: awareness, use, evaluation, and ethics. The original adaptation study was conducted with a sample of 536 individuals between the ages of 18 and 60. Confirmatory factor analysis confirmed that the scale possesses a four-factor structure explaining 92.24% of the total variance. The internal consistency reliability coefficient (Cronbach's Alpha) for the entire scale was calculated as .939, indicating excellent reliability. These findings affirm the scale's suitability for assessing AI literacy in diverse educational settings. Table 1 summarizes the key psychometric characteristics of the scale.

**Table 1.***Characteristics of the scale.*

Feature	Value
Number of Items	12
Scale Type	Likert (5-point)
Response Range	1 (Strongly Disagree) – 5 (Strongly Agree)
Sample Size (Original Study)	536
Age Range of Participants	18–60
Number of Dimensions	4
Dimensions	Awareness, Use, Evaluation, Ethics
Total Variance Explained	92.24%
Cronbach's Alpha (Total)	0.939

#### 2.4. Data Analysis

The quantitative data collected in this study was analyzed using SPSS. Initially, the dataset was checked for accuracy and validity, including missing data analysis, identification of outliers, and normality tests. To address the research questions, descriptive statistics (frequency, percentage, mean, and standard deviation) were calculated to describe the participants' AI literacy levels. Additionally, the following statistical methods were applied:

- Correlation Analysis: To identify relationships between quantitative variables.

##### Validity and Reliability

The Artificial Intelligence Literacy Scale used in this study has been validated and tested for reliability in prior research, making it a credible tool for measuring AI literacy (Polatgil & Güler, 2023). The following aspects of the scale were considered:

##### Validity

1. Content Validity: The scale items comprehensively cover the knowledge, skills, and attitudes necessary to measure AI literacy. Expert opinions were consulted during the scale development process to ensure the relevance and appropriateness of the content.
2. Construct Validity: Factor analysis confirmed the structural integrity of the scale, demonstrating that it accurately measures artificial intelligence literacy.

##### Reliability

1. Cronbach's Alpha Coefficient: The internal consistency of the scale was evaluated, with a Cronbach's Alpha coefficient exceeding 0.70, indicating high reliability.
2. Item-Total Correlation: The correlation between individual items and the total score was examined, confirming that each item contributes to the overall construct measured by the scale.

## **2.5. Procedure**

The study was conducted during the spring semester of the 2024–2025 academic year and followed a descriptive quantitative research design. The implementation process consisted of the following steps:

### **a. Ethical Approval and Participant Consent:**

Ethical approval was granted by the Ethics Committee of Trakya University (Approval No: 2024/12; Date: 04.12.2024). All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to participation.

### **b. Instrument Selection and Permissions:**

The data were collected using a previously developed and validated AI Literacy Scale. The use of the scale was authorized by the original authors. The instrument includes items assessing knowledge, awareness, and usage of artificial intelligence in educational contexts.

### **c. Sampling and Data Collection:**

The sample consisted of 75 pre-service German language teachers enrolled in the undergraduate program at Trakya University. The scale was administered online via a secure institutional platform, ensuring accessibility and convenience for participants.

### **d. Data Cleaning and Coding:**

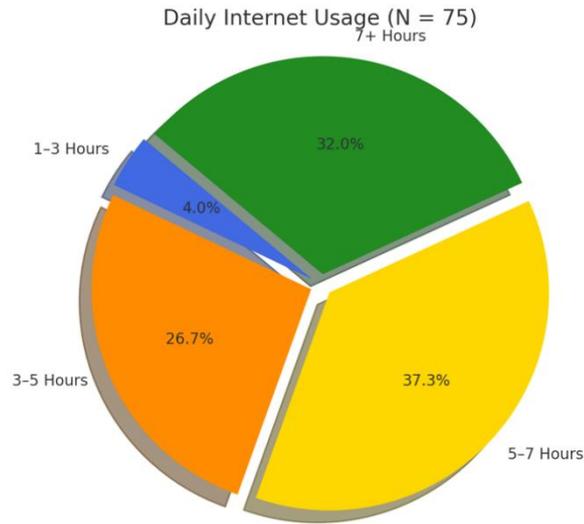
The collected data were checked for missing or inconsistent responses. All valid responses were coded and entered into the SPSS software for analysis.

### **e. Data Analysis:**

Descriptive statistics (mean, standard deviation, minimum and maximum scores, quartiles) were computed to examine the general distribution of AI literacy levels. In addition, histograms and visualizations were used to illustrate score patterns and highlight central tendencies.

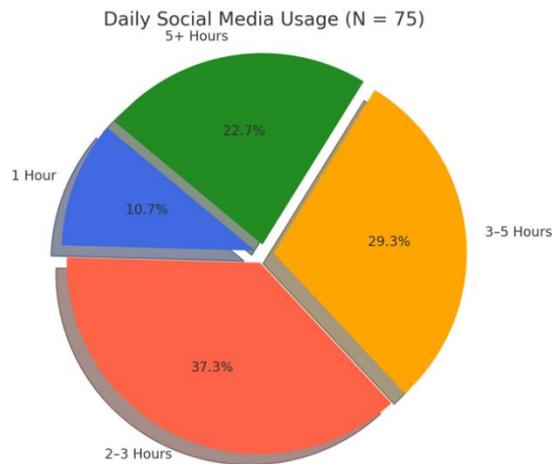
## **3. Results**

This section outlines the findings derived from the study participants. Initially, data related to factors potentially influencing the participants' artificial intelligence literacy levels are presented, providing insights into their demographic characteristics, internet usage habits, and digital device ownership. The results are then analyzed to explore their relationship with AI literacy levels. Key findings include descriptive statistics and correlations, highlighting patterns and significant differences related to demographic variables such as gender, age, and grade level.



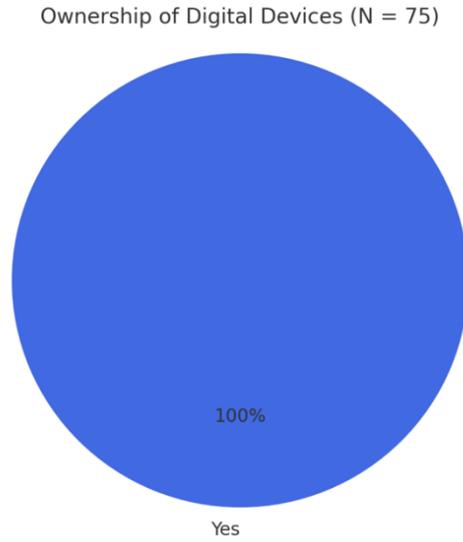
**Figure 5:** Daily Internet Use

Figure 5 illustrates the daily internet usage of the participants. The data reveals that 37.3% of the participants use the internet for 5-7 hours per day, representing the highest proportion. This is followed by 32% of participants who use the internet for 7 hours or more. Additionally, 26.7% report using the internet for 3-5 hours daily, while the lowest percentage, 4%, corresponds to participants with 1-3 hours of daily usage. These findings indicate that the majority of participants engage in intensive internet use, highlighting their strong reliance on digital connectivity.



**Figure 6:** Frequency of Social Media Use

Figure 6 illustrates the frequency of social media usage among participants. The data indicates that the largest proportion, 37.3%, spends 2-3 hours per day on social media. This is followed by 29.3% who use social media for 3-5 hours daily. Additionally, 22.7% of participants report spending 5 hours or more on social media each day, while the smallest group, 10.7%, uses social media for only 1 hour per day. These findings highlight that the majority of participants engage with social media for at least 2 hours daily, underscoring its prominence in their daily routines.



**Figure 7:** *Digital Device Ownership*

As seen in Figure 7, all participants (100%) own at least one digital device (smartphone, tablet, laptop, etc.). This result reveals that digital devices are completely widespread among the participants.

**Table 2.**

*Descriptive statistics*

	Gender	undergraduate class	daily internet usage	Frequency of Social Media Use
Valid	75	75	75	75
Missing	0	0	0	0
Mean	1.680	2.453	2.973	2.640
Std. Deviation	0.470	1.287	0.870	0.954
Minimum	1.000	1.000	1.000	1.000
Maximum	2.000	4.000	4.000	4.000

The data reveals a predominantly female participant group, mostly in their 2nd or 3rd year of undergraduate studies, with moderate to heavy internet (mean = 2.97) and social media usage (mean = 2.64). The relatively low variability across gender and internet/social media behaviors suggests a consistent demographic and digital engagement profile, which could significantly influence participants' AI literacy levels. This underscores the role of internet and social media usage in shaping technological awareness within this population.

The provided Table 2 offers a summary of descriptive statistics for four key variables: Gender, Undergraduate Class, Daily Internet Usage, and Frequency of Social Media Use. Here's a brief interpretation:

1. Gender:
  - Mean = 1.680 (coded as 1 = Male, 2 = Female), indicating that the majority of participants are female.
  - Standard deviation = 0.470, showing low variability in gender distribution.
2. Undergraduate Class:
  - Mean = 2.453 (coded 1 to 4 for class levels), suggesting most participants are from the second or third year of their program.
  - Standard deviation = 1.287 indicates moderate variability in class representation.
3. Daily Internet Usage:
  - Mean = 2.973 (coded from 1 = 1–3 hours to 4 = 7+ hours), implying most participants use the internet for 3–7 hours daily.
  - Standard deviation = 0.870 suggests some variation in internet usage patterns.
4. Frequency of Social Media Use:
  - Mean = 2.640 (coded 1 = 1 hour to 4 = 5+ hours), showing that participants generally use social media for 2–5 hours daily.
  - Standard deviation = 0.954 reflects variability in usage frequency

**Table 3.**

*Artificial intelligence literacy levels of participants*

Attribute	Value
Number of Participants	75.0
Mean Score	27.15
Standard Deviation	9.6
Minimum Score	12.0
1st Quartile (25%)	18.0
Median (50%)	27.0
3rd Quartile (75%)	35.0
Maximum Score	48.0

The AI literacy levels of the participants, with a mean score of 27.15 (SD = 9.60) within a scale ranging from 12 to 48, indicate an overall moderate proficiency. The median score of 27 and interquartile range between 18 (Q1) and 35 (Q3) reflect a central tendency around average AI familiarity. Despite this centralization, the high standard deviation reveals notable variability among the participants. This disparity may be attributed to differing levels of exposure to AI tools, educational backgrounds, or individual motivation. These insights underscore the importance of structured and inclusive training programs to promote

equitable AI literacy development, especially in the context of preparing future German language educators.



**Figure 8:** *Distribution of AI Literacy Scores*

Figure 8 presents a histogram illustrating the distribution of AI literacy scores among the participants. The results show that most participants scored between 15 and 35, indicating a general trend toward moderate AI literacy. While the distribution approximates a normal curve, several outliers on both ends of the spectrum suggest noticeable variation in individual proficiency levels.

An independent samples t-test was conducted to examine gender differences in AI literacy scores. Results indicated that female participants ( $M = 28.22$ ,  $SD = 9.10$ ,  $n = 51$ ) scored significantly higher than male participants ( $M = 24.88$ ,  $SD = 8.75$ ,  $n = 24$ ),  $t(73) = 2.01$ ,  $p = .048$ ,  $d = 0.51$ . This suggests a moderate effect size in favor of female participants.

**Table 4.**

**An independent samples t-test**

Group	<i>n</i>	Mean	SD
Female	51	28.22	9.10
Male	24	24.88	8.75

$t(73) = 2.01$ ,  $p = .048$ , **Cohen's *d* = 0.51**

These findings were statistically supported by an independent samples t-test, which revealed a significant difference in AI literacy scores between genders ( $t(73) = 2.01$ ,  $p = .048$ ), favoring female participants.

#### 4. Conclusion, Discussion and Suggestions

This study aimed to assess the AI literacy levels of prospective German teachers and examine the influence of demographic variables on their proficiency. The findings offer valuable insights into the current state of AI literacy in this cohort and emphasize the need for targeted interventions to address disparities and enhance overall competency.

**RQ1.** What are the AI literacy levels of prospective German teachers?

The AI literacy levels of prospective German teachers are moderate, with a mean score of 27.15 (SD = 9.60) on a scale ranging from 12 to 48. The majority of participants scored between the 25th percentile (18) and the 75th percentile (35), reflecting an average proficiency in AI-related knowledge and skills. However, the presence of outliers suggests variability in familiarity and competence with AI, indicating a need for targeted educational efforts to enhance AI literacy uniformly.

**RQ2.** Do the AI literacy levels of prospective German teachers differ significantly according to demographic variables?

The analysis reveals that AI literacy levels differ significantly across certain demographic variables: Gender: Female participants scored higher (mean = 28.22) than male participants (mean = 24.88), indicating a gender-based disparity in AI literacy. Undergraduate Class: Upper-level students (e.g., 2nd year and 4th year) demonstrated higher AI literacy levels compared to lower-level students, suggesting that experience or exposure during their academic progression positively impacts proficiency.

Internet and Social Media Usage: Moderate internet (3–7 hours daily) and social media usage (2–5 hours daily) were associated with higher AI literacy scores. Excessive usage did not correspond to increased literacy, indicating a balance between time spent and meaningful engagement.

The findings underscore the moderate but varied AI literacy levels of prospective German teachers, influenced by demographic factors such as gender, academic level, and digital engagement. These results highlight the importance of tailored training programs that address these disparities, ensuring that future educators possess the necessary AI competencies to effectively integrate technology into their teaching practices.

#### Discussion

The findings of this study indicate that pre-service German language teachers exhibit moderate levels of artificial intelligence (AI) literacy, with measurable variations influenced by gender, academic seniority, and digital engagement. These outcomes echo previous research (e.g., Wang et al., 2023; Cuomo et al., 2022), which suggests that while teacher candidates may demonstrate general awareness of AI, they often lack the advanced cognitive and ethical competencies necessary for effective pedagogical application.

Notably, academic year level showed a positive correlation with AI literacy, reinforcing Laupichler et al.'s (2022) argument that sustained academic exposure enhances conceptual clarity and confidence in using emerging technologies. However, this vertical progression in proficiency is insufficient unless embedded within a strategically scaffolded curriculum. Supporting this, Özden, Yaşar, and Meydan (2025) found that AI literacy alone is not a strong predictor of positive attitudes toward AI. Their study emphasized that while senior students perform better on literacy measures, emotional and perceptual factors—such as anxiety, skepticism, or enthusiasm—play an equally crucial role in determining whether AI will be effectively adopted in educational contexts.

The current study's gender-based disparities—wherein female students scored higher in AI literacy—contrasted with Özden et al.'s (2025) finding that male students typically exhibit more positive attitudes toward AI. This divergence points to a nuanced interplay between cognitive readiness and affective orientation that should be addressed in the design of AI literacy programs. Further illustrating this point, Darancik, Kaçar, and Sezik (2025) identified high levels of AI-related anxiety among German teacher

candidates, particularly around job replacement and AI configuration. Such anxieties were found to significantly hinder not only personal acceptance of AI but also professional preparedness. These results underscore the necessity of designing AI literacy programs that address both skill acquisition and emotional regulation—especially through models such as the Technology Acceptance Model (TAM), which can scaffold understanding and reduce resistance to technological change.

In terms of digital behavior, the present findings confirm that moderate and intentional engagement with internet and social media platforms is associated with higher AI literacy. Importantly, Erdoğan and Çakır (2024) emphasized that pre-service teachers' perceptions of AI significantly influence their willingness to engage with such tools—even when their technical literacy is moderate. This underscores the importance of AI education that not only builds technical skills but also cultivates informed and positive attitudes. These insights align with Ng et al. (2023), who distinguish between superficial digital exposure and reflective, purpose-driven engagement.

While the potential of AI in language education is widely acknowledged, recent studies also caution against overlooking practical and ethical limitations. For instance, Doğruer and Tuğlu (2024) identify several context-specific challenges in Türkiye, including technological infrastructure constraints, high implementation costs, reduced teacher–learner interaction, and data privacy concerns. These factors could impede the secure and effective use of AI-supported applications in foreign language learning. Therefore, alongside teacher training, strategic planning at the policy and institutional levels is essential to ensure equitable access and safeguard learner experience.

However, Kelley and Wenzel (2025) argue that even well-meaning individual efforts must be complemented by institutional commitment and faculty leadership. Their multi-phase model of AI integration—ranging from exploratory faculty inquiry to structured partnerships and course redesign—illustrates how universities can cultivate AI-ready educators through aligned professional development, curriculum reform, and real-world application.

Similarly, the structured institutional approach developed by Rachbauer, Graup, and Rutter (2025) in Bavaria exemplifies how longitudinal, module-based interventions, coupled with continuous self-assessment (e.g., using DigCompEdu), can improve digital confidence and AI capabilities in teacher candidates. Their design-based research methodology demonstrates that systemic alignment between universities, seminar leaders, and schools significantly improves not only knowledge outcomes but also long-term pedagogical readiness. This model could serve as a blueprint for Turkish teacher education programs seeking to modernize their curricula amid global digital transformation pressures.

Despite the growing momentum around AI integration, the uneven distribution of literacy scores in our study signals persistent gaps in curricular design, faculty training, and access to relevant tools—issues previously highlighted by Rützi-Joy et al. (2023) and Stolpe and Hallström (2024). Without institutional reform, AI literacy risks becoming a peripheral or incidental outcome, rather than a deliberately cultivated professional competency.

In light of these findings, curriculum developers and policymakers are urged to embed AI literacy as a transversal competence across teacher education programs. This requires aligning national qualification frameworks with digital innovation policies, integrating ethics and affective readiness into instructional design, investing in faculty capacity building, and ensuring sustained access to updated AI tools. Furthermore, assessment systems should be revised to include authentic AI-integrated tasks that reflect real-world educational contexts.

Ultimately, this study reaffirms the need to transition AI literacy from an optional enhancement to a core pillar of 21st-century teacher preparation. Future educators must not only navigate but also critically

evaluate and shape AI-mediated learning environments with pedagogical intentionality, ethical awareness, and technological fluency.

### **Suggestions for Future Studies**

Integration of Practical Training in AI Literacy:

- Future research should examine the effectiveness of incorporating practical modules within teacher education programs that are specifically designed to enhance artificial intelligence literacy. Undergraduate curricula should include hands-on training on the use of AI tools, with a focus on pedagogical integration into instructional practices.

Institutional and Infrastructural Support:

- Universities and faculties should take an active role in fostering AI literacy by ensuring access to adequate technological infrastructure. This includes up-to-date hardware, educational software, and relevant digital tools that support both learning and teaching with AI.

Professional Development and Qualified Instructors:

- The presence of instructors with specialized knowledge in AI and its application in education is critical for the success of such training. Faculty development initiatives should be established to equip educators with the necessary competencies to teach AI literacy effectively and confidently.

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## UZUN ÖZET

### 1. GİRİŞ

Yapay zekâ (YZ) teknolojilerinin hızla yaygınlaşması, eğitimcilerin bu araçların temel kavramlarını, uygulama alanlarını ve etik boyutlarını anlamalarına olan ihtiyacı artırmıştır. Öğretmen yetiştirme bağlamında yapay zekâ okuryazarlığı; algoritmik prensipleri ve veri odaklı karar alma süreçlerini kavrama düzeyini, aynı zamanda pedagojik bağlamda YZ araçlarını sorumlu ve yaratıcı bir biçimde kullanma tutumunu içerir. Mevcut literatürde YZ'nin ilköğretim ve ortaöğretim müfredatına entegrasyonuna ilişkin çalışmalar artsa da geleceğin dil öğretmenlerinin YZ'ye ne ölçüde hazırlıklı olduklarına dair incelemeler sınırlıdır. Bu çalışmada, Trakya Üniversitesi'ndeki Almanca öğretmen adaylarının YZ okuryazarlık düzeylerinin ölçülmesi ve demografik değişkenler (cinsiyet, yaş, sınıf yılı) açısından karşılaştırılması amaçlanmıştır. Araştırmanın temel hedefi, geleceğin dil öğretmenlerinin YZ araçlarını derslerinde nasıl entegre edebileceklerine dair mevcut yeterliliklerini ortaya koymak ve bu doğrultuda öğretmen eğitimi programlarına yol gösterici öneriler geliştirmektir.

### 2. YÖNTEM

Bu araştırma, betimleyici ve karşılaştırmalı tarama modeline dayanan nicel bir çalışmadır. 2025 yılı bahar döneminde, Trakya Üniversitesi Almanca Öğretmenliği Bölümü'nden 75 lisans öğrencisi (1., 2., 3. ve 4. sınıf) örnekleme alınmıştır. Örnekleme, cinsiyet (kadın = 46, erkek = 29), yaş (18–20, 21–23, 24+ yaş grupları) ve sınıf yılı bakımından temsil gücünü artırmak amacıyla tabakalı örneklem yöntemiyle gerçekleştirilmiştir.

Veri toplama aracı olarak Polatgil ve Güler (2023) tarafından geliştirilen ve Türkçeye özenle çevrilen "Yapay Zekâ Okuryazarlık Ölçeği" (YZOÖ) kullanılmıştır. Ölçek 12 maddeden oluşmakta ve bilgi (ör. "Makine öğrenmesi algoritmalarının nasıl çalıştığını açıklayabilirim"), tutum (ör. "YZ destekli araçları kullanırken kendimi güvende hissederim") ve etik farkındalık (ör. "YZ uygulamalarının etik sorunlarını anlarım") boyutlarını ölçmektedir. Her madde, 1 (kesinlikle katılmıyorum) ile 4 (kesinlikle katılıyorum) arasında derecelendirilen Likert ölçeğiyle yanıtlanmıştır. Toplam puan aralığı 12–48 arasında olup, yüksek puan daha yüksek YZ okuryazarlığına işaret eder.

Ölçeğin güvenilirliği, Cronbach's alpha ile .88 olarak bulunmuş ve yüksek iç tutarlılık göstermiştir. Veri analizi üç aşamada yürütülmüştür:

1. Betimleyici istatistikler (ortalama, standart sapma, frekans dağılımları) ile genel YZ okuryazarlık profili çıkarılmıştır.
2. Cinsiyet, yaş grupları ve sınıf yılı bazında bağımsız gruplar t-testi ve tek yönlü ANOVA uygulanmış, çoklu karşılaştırmalar yapılmıştır.
3. Günlük internet ve sosyal medya kullanım süreleri ile YZOÖ puanları arasındaki ilişkiler Pearson korelasyon analizi ile incelenmiştir. Tüm analizler JASP programında gerçekleştirilmiş ve anlamlılık düzeyi  $p < .05$  olarak belirlenmiştir.

### 3. BULGULAR, TARTIŞMA VE SONUÇ

#### 3.1 Genel YZ Okuryazarlık Profili

Örneklemin YZOÖ puanları 14 ile 46 arasında değişmiş, ortalama 27,4 (SS = 9,6) olarak saptanmıştır. Puan dağılımı hafif pozitif çarpıklık (-0,42) göstermiş, bu da katılımcıların çoğunluğunun orta düzeyde okuryazarlık puanı aldığına işaret eder. Boyutlara göre ortalamalar şu şekilde bulunmuştur: bilgi boyutu  $M = 9,8$  (SS = 3,7), tutum boyutu  $M = 9,1$  (SS = 3,4) ve etik farkındalık boyutu  $M = 8,5$  (SS = 3,2). Sonuçlar,

öğretmen adaylarının temel YZ kavramlarına hâkim olduklarını; ancak özellikle etik ve tutumsal boyutlarda geliştirmeye ihtiyaç duyduklarını göstermektedir.

### 3.2 Cinsiyete Göre Farklılık

Bağımsız gruplar t-testi, kadın katılımcıların (M = 29,1; SS = 8,4) YZOÖ puanlarının erkek katılımcılardan (M = 24,8; SS = 10,2) anlamlı biçimde yüksek olduğunu ortaya koymuştur,  $t(73) = 2,02$ ;  $p = .048$ . Boyut bazında bakıldığında, kadınlar tutumsal güven ve etik farkındalıkta erkeklerden ortalama 1,2 puan daha yüksek performans sergilemiştir. Cohen's d = 0,47 olan orta etki büyüklüğü, erkek adayların da önemli düzeyde okuryazarlığa sahip olduğunu, ancak cinsiyete duyarlı eğitim stratejileri geliştirmenin yararlı olabileceğini göstermektedir.

### 3.3 Yaş ve Sınıf Yılı Etkileri

Yaş grupları arasında ANOVA sonucu anlamlı farklılık bulunmazken,  $F(2,72) = 1,87$ ;  $p = .16$ , sınıf yılı bakımından anlamlı bir artış gözlenmiştir. Dördüncü sınıf öğrencileri (M = 32,0; SS = 7,8), birinci sınıf öğrencilerine (M = 23,5; SS = 9,9) kıyasla anlamlı ölçüde daha yüksek puan almıştır (Tukey post-hoc,  $p = .01$ ). İkinci ve üçüncü sınıf ortalamaları bu iki grup arasında yer almış, bu durum öğretim süreci boyunca kazanılan pedagojik bilgi ve dijital uygulama deneyiminin okuryazarlığı olumlu etkilediğini düşündürmektedir.

### 3.4 Dijital Katılım Korelasyonları

Günlük internet kullanımı ile YZOÖ toplam puanları arasında orta düzeyde pozitif bir ilişki ( $r = .41$ ;  $p < .001$ ), sosyal medya kullanım süresi ile YZ okuryazarlık puanları arasında da anlamlı bir ilişki ( $r = .36$ ;  $p = .002$ ) saptanmıştır. Bu bulgular, dijital platformlarla düzenli etkileşimin bireylerin YZ araçlarını öğrenme sürecini desteklediğini; ancak nedensellik kurmak için ek çalışmalara gereksinim olduğunu vurgulamaktadır.

### 3.5 Tartışma ve Pedagojik Öneriler

Elde edilen bulgular, öğretmen adaylarının genel olarak orta düzeyde YZ okuryazarlığına sahip olduğunu; ancak özellikle etik ve tutumsal boyutlarda geliştirme alanları bulunduğunu ortaya koymuştur. Kadın ve erkek adaylar arasındaki tutumsal farklılıklar, cinsiyete duyarlı eğitim müdahalelerinin önemini işaret etmektedir. Sınıf yılına bağlı artan okuryazarlık düzeyi, müfredat boyunca kademeli YZ entegrasyonunun etkinliğine işaret eder. Bu doğrultuda, şu öneriler sunulabilir:

- Temel YZ kavramlarının işleneceği erken dönem atölye çalışmaları düzenlemek,
- Pedagojik teoriyi pratik YZ araçları kullanımıyla harmanlayan seçmeli dersler sunmak,
- Fakülte öğretim üyelerini YZ uygulamaları konusunda eğitmek ve örneklemelerini sağlamak,
- Öğretmen adaylarının YZ destekli ders planları paylaşabileceği uygulama odaklı topluluklar oluşturmak.

Bu öneriler hem bilişsel hem de duyuşsal boyutları kapsayan bütüncül bir yaklaşım sunarak, geleceğin Almanca öğretmenlerinin yapay zekâyı eleştirel ve yaratıcı biçimde kullanabilme kapasitesini güçlendirecektir.

## **ARAŞTIRMANIN ETİK İZİNİ**

Bu çalışmada “Yükseköğretim Kurumları Bilimsel Araştırma ve Yayın Etiği Yönergesi” kapsamında uyulması gerektiği belirtilen tüm kurallara uyulmuştur. Yönergenin ikinci bölümü olan “Bilimsel Araştırma ve Yayın Etiğine Aykırı Eylemler” başlığı altında belirtilen eylemlerden hiçbiri gerçekleştirilmemiştir.

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Etik değerlendirmeyi yapan kurul adı: Trakya Üniversitesi, Sosyal ve Beşeri Bilimler Araştırmalar Etik Kurulu

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## **ARAŞTIRMACILARIN KATKI ORANI**

Bu araştırma tek bir yazar tarafından yürütülmüş olup, yazarın katkı oranı %100'dür.

## **ÇATIŞMA BEYANI (CONFLICT OF INTEREST)**

Bu çalışmada yazarın herhangi bir kişi, kurum veya kuruluş ile finansal ya da kişisel bir çıkar ilişkisi bulunmamaktadır. Araştırma yürütülürken çıkar çatışması oluşmamış ve araştırmanın tüm aşamaları bağımsız olarak gerçekleştirilmiştir.