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# Perceived Digital Competence and Basic AI Understanding in Relation to Academic Use Among Teacher Education Students

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## Abstract

Artificial intelligence has become increasingly present in education, offering tools that can support teaching and learning while also raising concerns regarding their effective, ethical, and responsible use. This study examined primary teacher education students' perceived digital competence and basic understanding of artificial intelligence, their reported use of artificial intelligence tools for studying, and the relationship between these constructs. The research was conducted using an anonymous online survey with 82 students enrolled in primary teacher education programs in Serbia. Exploratory factor analysis supported a two-factor structure comprising *Perceived Digital Competence and Basic Artificial Intelligence Understanding* and *Use of Artificial Intelligence Tools in Studying*, which together explained 54.46% of the total variance. Both factors demonstrated satisfactory internal consistency, with Cronbach's alpha coefficients of 0.884 and 0.874, respectively. Participants reported relatively high perceived digital competence and basic artificial intelligence understanding ($M = 6.24$, $SD = 1.18$) but lower use of artificial intelligence tools in studying ($M = 3.59$, $SD = 1.83$) on an eight-point Likert-type scale. No statistically significant differences were found across years of study for either factor ($\rho = 0.850$ and 0.104, respectively), and the association between the first factor and tool use was weak and not statistically significant ($\rho = 0.162$, $p = 0.145$). These findings indicate that perceived digital competence and basic artificial intelligence understanding should be considered separately from academic use and suggest that primary teacher education programs should provide structured opportunities for future primary teachers to apply artificial intelligence tools critically, ethically, and pedagogically in authentic academic and teaching-related activities.

**Keywords:** artificial intelligence, digital competencies, teacher education, factor analysis, AI tools.

**MSC2020:** 97P80, 97P99, 97U99

## 1. Introduction

The rapid emergence of generative artificial intelligence (AI) tools has begun to reshape educational practice by enabling students and educators to generate explanations and learning materials, receive automated feedback, support lesson planning, and access information more efficiently. These applications create new opportunities for personalized learning and instructional

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support, while also requiring users to critically evaluate AI-generated content. At the same time, the growing use of AI in education has raised concerns related to academic integrity, ethical use, the reliability of AI-generated content, overreliance on technology, and broader implications for teaching, learning, and assessment (Mao et al., 2023; Garzón et al., 2025). These issues are particularly important in teacher education, as future teachers are expected not only to use AI tools in their own studies but also to evaluate their pedagogical value and guide students in their responsible use. Therefore, examining pre-service teachers' perceived digital and AI competencies, as well as their use of AI tools, is important for understanding their preparedness for these emerging professional demands.

In higher education, generative AI tools are increasingly becoming part of students' academic practices. They are used for activities such as searching for information, summarizing academic materials, completing assignments, preparing for examinations, and supporting independent learning. Among pre-service teachers, previous experience with AI tools has also been reported, along with generally positive attitudes toward their educational use (Mustafaoğlu & Alkan, 2025). Recent studies indicate that both students and faculty recognize the potential of AI in higher education, while emphasizing the importance of developing appropriate competencies and ethical guidelines to support its effective and responsible use (Schmidt et al., 2025).

Students enrolled in teacher education programs represent a particularly important group in the context of AI integration in education, as they are both current users of AI tools and future professionals expected to evaluate and apply these technologies pedagogically. Guan et al. (2025) found that pre-service teachers used AI selectively, often regarded it primarily as a functional tool, and reported gaps in their understanding of AI fundamentals and ethics. Their findings highlight the need to prepare future teachers for the changing roles and responsibilities associated with AI-integrated education. Similarly, Lucas et al. (2025) reported that pre-service teachers may not yet be fully prepared to integrate AI into their future teaching, which they attributed to the limited systematic integration of AI-related competencies and pedagogical applications into initial teacher education programs. Developing the capacity to use AI effectively, critically, and responsibly is therefore becoming an increasingly important aspect of teacher preparation. At the same time, future educators generally recognize AI's potential to support learning and enhance educational practice, while emphasising the importance of preserving human interaction and ensuring the responsible use of AI technologies (Miranda, 2025).

Despite the growing body of research on AI in education, several aspects of pre-service teachers' AI-related competencies and academic practices remain insufficiently investigated. Previous studies involving pre-service teachers have examined AI integration in education (Miranda, 2025), AI literacy (Chenqi et al., 2023), attitudes toward AI (Mustafaoğlu & Alkan, 2025), and preparedness for AI-integrated education (Lucas et al., 2025; Guan et al., 2025). More closely related to the present research, Benyahia (2025) examined pre-service teachers' experiences and practices regarding AI use, while Musood and Kaur (2025) investigated the relationship between digital competence and attitudes toward AI among pre-service teachers in India. However, the relationship between pre-service teachers' digital competence and AI knowledge, on the one hand, and their use of AI tools in academic activities, on the other, remains insufficiently examined. Moreover, empirical evidence concerning these constructs within the Serbian teacher education context remains scarce.

Accordingly, the aim of this study was to develop an instrument for assessing perceived digital competence, basic AI understanding, and academic AI use among students enrolled in primary teacher education programs, and to examine its factor structure and internal consistency in the present sample. The study contributes to the existing literature by integrating perceived digital competence and basic AI understanding with reported academic AI use within a single concise instrument and by examining the relationship between these dimensions. It also provides context-

specific empirical evidence from Serbia, thereby extending the geographical scope of research on future primary school teachers' preparedness for AI-integrated education.

## 2. Theoretical Background

Digital competence is generally understood as the ability to use digital technologies effectively and appropriately to accomplish tasks and solve problems in various contexts. In teacher education, digital competence is considered a key prerequisite for the successful integration of technology into teaching and learning processes (Tondeur et al., 2018). AI-related competencies are closely connected to digital competence but represent a more specific construct. Whereas digital competence concerns the broader use of digital tools and environments, AI-related competencies additionally involve knowledge of AI systems, the ability to use and evaluate them, and awareness of ethical issues and responsible use (Chenqi et al., 2023). Accordingly, general digital proficiency does not necessarily imply adequate preparedness to evaluate and use AI technologies in educational contexts. Previous research suggests that higher levels of digital competence are associated with more positive attitudes toward the educational use of AI, highlighting the importance of preparing future educators for AI-enhanced learning environments (Galindo-Domínguez et al., 2025).

Several instruments have been developed to assess different aspects of teachers' and pre-service teachers' preparedness for digital and AI-supported education. However, these instruments differ considerably in their scope and intended purpose. The Digital Competency Scale for Teachers, developed by Gümüş and Kukul (2023), provides a comprehensive assessment of general digital competence across six dimensions, but its 46-item structure is relatively extensive and not specifically focused on AI-related competencies or academic AI use. By contrast, AI literacy instruments developed for pre-service teachers focus more specifically on AI knowledge, skills, pedagogy, and ethical awareness. Pingmuang et al. (2024), for example, proposed a 39-item scale covering recognition, fundamental comprehension, pedagogy, and ethical use, whereas Chenqi et al. (2023) conceptualized AI literacy through AI knowledge, AI ability, and AI awareness and ethics. Although these instruments provide comprehensive assessments of AI literacy, they do not directly examine how perceived competencies are reflected in students' use of AI tools in academic activities. Attitude-oriented measures, such as the General Attitudes towards Artificial Intelligence Scale, address a different construct by assessing positive and negative orientations toward AI rather than competencies or patterns of use (Cicero et al., 2024). Therefore, the existing instruments were not fully aligned with the purpose of the present study, which required a concise measure that could simultaneously assess perceived digital competence and basic AI understanding alongside the reported academic use of AI tools, allowing the relationship between these dimensions to be examined.

The use of AI tools in higher education has expanded rapidly, providing students with new opportunities for personalized learning, timely feedback, and academic support. Previous research suggests that students generally perceive AI as a valuable educational resource that can improve learning experiences, support critical thinking, and facilitate various academic tasks (Mohamed et al., 2025; Slimi et al., 2025). However, studies involving pre-service teachers indicate considerable variation in both the frequency and purposes of AI use. Yalçın (2026) reported that Turkish language pre-service teachers frequently used tools such as ChatGPT, Canva AI, Microsoft Copilot, and DeepSeek for content creation, homework support, information retrieval, and in-depth learning, and found a strong positive relationship between their AI competence and attitudes toward AI. At the same time, Benyahia (2025) found that although nearly all pre-service teachers had previous experience with AI tools, their use was predominantly occasional and concentrated on academic support rather than teaching-related activities. These contrasting findings suggest that familiarity with AI and positive attitudes do not necessarily correspond to uniform patterns of academic use across educational contexts. At the same time, concerns have been raised regarding learner

autonomy, ethical use, academic integrity, and the potential impact of AI on students' well-being and interpersonal interactions (Han et al., 2025; Klimova & Pikhart, 2025). Such variation highlights the importance of examining students' perceived AI-related competencies and their reported academic use as related but distinct dimensions.

The reviewed literature highlights the growing importance of preparing future educators for educational environments increasingly shaped by digital technologies and artificial intelligence. It also indicates that perceived digital competence and basic AI understanding, on the one hand, and the academic use of AI tools, on the other, represent related but conceptually distinct dimensions whose levels and interrelationship may vary across educational contexts. Accordingly, the present study examines the factor structure and internal consistency of the proposed instrument, the levels of these dimensions among students enrolled in primary teacher education programs in Serbia, possible differences across years of study, and whether perceived digital competence and basic AI understanding are associated with the reported academic use of AI tools.

## 3. Research Questions

The study had two main objectives. The first was to develop an instrument to assess students enrolled in primary teacher education programs regarding their perceived digital competence and basic AI understanding, as well as their use of AI tools for studying, and to examine its factor structure and internal consistency in the present sample. The second was to examine these dimensions among such students in Serbia. Accordingly, the following research questions were formulated:

RQ1. What is the level of future primary school teachers' perceived digital competence and basic AI understanding?

RQ2. To what extent do future primary school teachers use AI-based tools in studying?

RQ3. Are there statistically significant differences in future primary school teachers' digital competence and basic AI understanding or their use of AI-based tools according to their year of study?

RQ4. Is perceived digital competence and basic AI understanding significantly associated with the use of AI tools in studying among future primary school teachers?

## 4. Methodology

This section describes the study's methodology, including the study design, participants, instrument, data collection procedures, psychometric evaluation, and statistical analysis.

### 4.1. Study Design and Participants

This study employed a cross-sectional survey design to examine the target constructs among students enrolled in teacher education programs in Serbia. Data were collected between January and March 2026 using an anonymous online questionnaire. A convenience sampling approach was employed. The survey link was distributed by the authors and through colleagues, who shared it with eligible students. Participation was voluntary.

The sample comprised 82 students enrolled in primary teacher education programs at faculties of education in Serbia. These students were preparing to become primary classroom teachers, responsible for teaching Grades 1-4 within the Serbian education system. Participants represented different stages of study, ranging from first-year undergraduate students to master's-level students. A detailed distribution of the sample is presented in Table 1.

Table 1. Distribution of Participants by Year of Study

| Year of study | ***N*** | % |
|---|---|---|
| First year | 16 | 19.5 |
| Second year | 17 | 20.7 |
| Third year | 17 | 20.7 |
| Fourth year | 20 | 24.4 |
| Master's level | 12 | 14.6 |
| Total | 82 | 100 |

### 4.1. Instrument

The questionnaire was developed by the authors as part of a broader survey of teachers and teacher education students. It was not directly adapted from an existing validated scale; rather, item development was informed by previous research on digital competence, AI literacy, and the academic use of AI tools. The initial questionnaire included a broader set of questions, from which 13 items directly relevant to the aims of the present study were selected. The items were jointly reviewed by the authors for conceptual relevance, clarity, and alignment with the two intended domains: perceived digital competence and basic AI understanding and the use of AI tools in academic contexts. No separate expert validation or pilot study was conducted.

The instrument comprised 13 items rated on an eight-point Likert-type scale ranging from 1 (*strongly disagree*) to 8 (*strongly agree*). An even-numbered scale was selected to remove the neutral midpoint and use a forced-choice response format. Eight categories were used to enable finer differentiation of responses while remaining manageable for the university student population. As Froman (2014) notes, response scales should provide enough options to distinguish respondents' degrees of agreement, but not so many that they increase complexity or respondent burden. The items addressed students' self-perceived digital competence and basic AI understanding and their use of AI-based tools for academic activities, such as completing assignments, preparing for examinations, communicating with instructors, and supporting learning processes. The factor structure and internal consistency of the instrument are presented in the following section.

### 4.2. Psychometric Evaluation

The psychometric properties of the instrument were examined using exploratory factor analysis (EFA) with Principal Axis Factoring as the extraction method. The adequacy of the data for factor analysis was supported by the Kaiser–Meyer–Olkin measure of sampling adequacy ($\mathrm{KMO} = 0.784$) and by Bartlett's test of sphericity, which was statistically significant ($\chi^2(78) = 648.867$, $p < 0.001$). However, given the relatively small sample size, the resulting factor structure should be interpreted with caution and further examined in future studies using larger and independent samples.

An initial analysis using Direct Oblimin rotation yielded three factors with eigenvalues greater than 1. The third factor comprised three items reflecting basic AI understanding and was moderately correlated with the broader digital competence factor ($r = 0.491$). Because the digital competence factor and the three-item AI understanding factor were moderately correlated and represented closely related aspects of the intended competence domain, a more parsimonious two-factor solution was subsequently examined. The two-factor Direct Oblimin solution produced a theoretically interpretable item grouping, and the correlation between the two retained factors was low ($r = 0.166$). The analysis was therefore repeated using Varimax rotation, which yielded the same item grouping and was retained for reporting.

The two factors together explained 54.46% of the total variance. Items with primary loadings of at least .40 and without substantial cross-loadings were considered acceptable. All 13 items met these criteria: primary loadings ranged from 0.564 to 0.848, while secondary loadings did not exceed 0.191.

The first factor, labelled Perceived Digital Competence and Basic AI Understanding (PDC-BAIU), consisted of eight items assessing self-perceived digital literacy and skills, as well as basic understanding, recognition, and differentiation of artificial intelligence tools. This factor accounted for 31.22% of the total variance after rotation. The factor loadings for these items ranged from 0.564 to 0.804, indicating that they represented a coherent dimension of students' perceived digital competence and basic understanding of AI.

The second factor, labelled Use of AI Tools in Studying, included five items assessing the use of AI-based tools in various academic contexts, such as completing assignments, preparing for examinations, communicating with instructors, and supporting learning processes. This factor explained 23.24% of the total variance after rotation. The factor loadings ranged from 0.646 to 0.848, supporting a coherent dimension of students' reported use of AI technologies in studying.

The rotated factor matrix is presented in Table 2. Overall, the results of the exploratory factor analysis supported the interpretability of a two-factor solution comprising: (1) *PDC-BAIU* and (2) *Use of AI Tools in Studying*. This solution is consistent with the intendent two-domain framework underlying the development of the instrument.

Table 2. Rotated Factor Matrix of the Study Instrument

| Item | Factor | |
|---|---|---|
| | PDC-BAIU | Use of AI Tools in Studying |
| I consider myself digitally literate and possessing digital competencies. | **0.774** | 0.191 |
| I am confident in my ability to use digital devices in professional contexts. | **0.804** | 0.115 |
| I understand the basic digital tools used in education. | **0.735** | 0.059 |
| I believe I have sufficient skills to independently solve technical problems on a computer or tablet. | **0.733** | -0.016 |
| I learn to use new digital tools and applications easily. | **0.780** | -0.002 |
| I understand the basic concepts of artificial intelligence. | **0.632** | 0.112 |
| I can distinguish between traditional digital tools and AI-based tools. | **0.598** | -0.077 |
| I can provide examples of applications that use artificial intelligence. | **0.564** | 0.184 |
| I use AI-based tools to complete assignments and coursework. | -0.062 | **0.769** |
| I use AI-based tools to communicate with professors. | 0.077 | **0.646** |
| I use AI-based tools to prepare for exams. | 0.044 | **0.848** |
| I use AI-based tools to follow lectures and support learning. | 0.176 | **0.747** |
| I use AI-based tools for other academic activities (e.g., summarizing literature). | 0.110 | **0.794** |
| Extraction method: Principal Axis Factoring. Rotation method: Varimax with Kaiser Normalization. Rotation converged in three iterations. Note. PDC-BAIU = Perceived Digital Competence and Basic AI Understanding. | | |

The internal consistency of the identified factors was assessed using Cronbach's alpha coefficient. The results indicated good reliability for both scales. The *PDC-BAIU* factor demonstrated high internal consistency ($\alpha = 0.884$), while the *Use of AI Tools in Studying* factor also showed high reliability ($\alpha = 0.874$). These findings provide evidence of satisfactory internal consistency for both factors in the present sample.

### 4.3. Data Analysis

Data were analyzed using IBM SPSS Statistics (Version 26). Descriptive statistics were reported as means and standard deviations. Differences between groups were examined using the Kruskal–Wallis test, with effect sizes estimated using ordinal eta-squared ($\eta_H^2$), calculated as $\eta_H^2 = (H - k + 1)/(N - k)$, where $H$ is the Kruskal-Wallis statistic, $k$ is the number of groups,

and $N$ is the total sample size. The relationship between two identified factors was examined using Spearman's rank-order correlation coefficient ($\rho$). Statistical significance was set at $\alpha = 0.05$. The results are presented in both textual and tabular form.

### 4.4. Ethical Considerations

Participation in the study was voluntary, and respondents completed the questionnaire anonymously via an online platform. Prior to participation, students were informed about the purpose of the study, the voluntary nature of participation, and the confidentiality of their responses. By proceeding with the questionnaire, participants provided their informed consent. No personally identifiable information was collected, and all data were analyzed in aggregated form.

## 5. Results

To address the first two research questions, descriptive statistics were calculated for the two identified dimensions of the instrument: *Perceived Digital Competence and Basic AI Understanding* and *Use of AI Tools in Studying*. The results are presented in Table 3.

Table 3. Descriptive Statistics for PDC-BAIU and Use of AI Tools in Studying

| Variable | *N* | Range | Minimum | Maximum | Mean | Standard Deviation | Variance |
|---|---|---|---|---|---|---|---|
| *PDC-BAIU* | 82 | 4.88 | 3.13 | 8.00 | 6.24 | 1.18 | 1.40 |
| *Use of AI Tools in Studying* | 82 | 7.00 | 1.00 | 8.00 | 3.59 | 1.83 | 3.34 |

Descriptive statistics indicated that the mean score for *PDC-BAIU* was relatively high ($M = 6.24$, $SD = 1.18$) on a scale ranging from 1 to 8, suggesting that students generally reported relatively high levels of perceived digital competence and a basic understanding of AI. In contrast, the mean score for *Use of AI Tools in Studying* was considerably lower ($M = 3.59$, $SD = 1.83$), indicating a relatively low level of reported use of AI tools in academic contexts. Descriptive statistics for both factors by year of study are presented in Table 4.

Table 4. Descriptive Statistics by Year of Study

| Year of study | *N* | PDC-BAIU | | Use of AI Tools in Studying | |
|---|---|---|---|---|---|
| | | Mean | Standard Deviation | Mean | Standard Deviation |
| First year | 16 | 5.98 | 1.16 | 3.56 | 1.92 |
| Second year | 17 | 6.18 | 1.26 | 4.11 | 1.86 |
| Third year | 17 | 6.38 | 1.11 | 3.71 | 1.62 |
| Fourth year | 20 | 6.25 | 1.24 | 3.71 | 1.79 |
| Master's level | 12 | 6.43 | 1.23 | 2.53 | 1.88 |

To address the third research question, differences in students' *PDC-BAIU* scores and their *Use of AI Tools in Studying* across study levels were examined using the Kruskal–Wallis test. The results are presented in Table 5.

Table 5. Kruskal–Wallis Test Results Across Year of Study

| Variable | $H$ | *Df* | *p* | $\eta_H^2$ |
|---|---|---|---|---|
| *PDC-BAIU* | 1.367 | 4 | 0.850 | −0.034 |
| *Use of AI Tools in Studying* | 7.686 | 4 | 0.104 | 0.048 |

The results indicated no statistically significant differences in *PDC-BAIU* scores across study levels, $H(4) = 1.367$, $p = 0.850$, $\eta_H^2 = -0.034$. The negative estimate was interpreted as zero,

indicating a negligible effect. Similarly, no statistically significant differences were found in *Use of AI Tools in Studying*, $H(4) = 7.686$, $p = 0.104$, $\eta_H^2 = 0.048$. The estimated effect size for *Use of AI Tools in Studying* was small.

Following the identification of the two factors, the relationship between *PDC-BAIU* and *Use of AI Tools in Studying* was examined using Spearman's rank-order correlation coefficient, as neither variable met the assumption of normality ($p < 0.05$). The analysis indicated a weak positive correlation ($\rho = 0.162,\ p = 0.145, N = 82$). However, the association was not statistically significant.

## 6. Discussion

The aim of this study was to examine perceived digital competence and basic AI understanding, as well as the use of AI tools, among students enrolled in primary teacher education programs in Serbia. The findings showed that participants reported relatively high levels of perceived digital competence and basic AI understanding, while their use of AI tools in academic activities remained comparatively limited. In addition, the association between these dimensions was weak and not statistically significant, indicating that higher scores on perceived digital competence and basic AI understanding did not necessarily correspond to more frequent academic use of AI tools in the present sample.

Similar patterns were observed in the study by Benyahia (2025), conducted among pre-service teachers in Algeria. Nearly all participants reported previous experience with AI tools, although their use was predominantly occasional and focused on academic support tasks rather than on teaching-related activities. Participants also generally expressed positive attitudes toward AI, while a substantial proportion reported neutral or uncertain views regarding its integration into teacher education. A comparable pattern was also observed by Milenković et al. (2026), who reported predominantly positive attitudes toward the use of GenAI tools in mathematics education among Serbian primary and secondary school students, although a considerable proportion of participants expressed cautious or mixed views.

Similar findings were reported by Miranda (2025) in a study conducted among teachers, university students, and pre-service teachers in Italy. The participants generally recognized the educational potential of AI, particularly its role in supporting personalized learning and improving teaching efficiency. At the same time, they emphasized the importance of its careful and responsible use, expressing strong reservations about replacing essential human elements of education, such as teachers, textbooks, and face-to-face instruction, with AI technologies.

Taken together, these findings suggest that although students and future teachers generally recognize the educational potential of AI, this positive perception is often accompanied by a cautious approach to its practical use. This observation is consistent with the present findings, in which students reported relatively high perceived digital competence and a basic understanding of AI, but comparatively limited use of AI tools for studying. However, this pattern is not uniform across contexts, as Yalçın (2026) reported more frequent and diverse educational use of AI tools among Turkish language pre-service teachers. Such differences may reflect variation across educational programs and national contexts, although the factors underlying these patterns were not directly examined in the present study.

Because the present study did not directly examine how students acquired their competencies, the extent of curricular AI integration, or their reasons for using or avoiding AI tools, the following explanations should be regarded as tentative and warrant further investigation. One possible explanation for these findings is that students may acquire many of their digital and AI-related skills informally through everyday interactions with digital technologies, social media, and online platforms. However, the educational use of AI tools may depend on additional factors, including the extent to which such technologies are integrated into teaching and learning activities. In many higher education contexts, AI tools are still not systematically incorporated into teaching and

learning activities, which may limit opportunities for their meaningful academic use. Previous research has shown that students may express more positive attitudes toward educational technologies when they are purposefully integrated into coursework and accompanied by appropriate guidance. For example, Stakić et al. (2021) found that students enrolled in teacher education programs responded positively to the use of Wikipedia as a teaching tool after being actively engaged in creating and editing content as part of their academic work.

Another interesting finding was that students' perceived digital competence and basic understanding of AI were not significantly correlated with their use of AI tools for studying. Within the present sample, no statistically significant association was observed between these two variables. Yalçın (2026) likewise reported generally positive perceptions of AI among pre-service teachers, although the relationship examined in that study concerned self-reported AI competence and attitudes rather than academic use of AI. Reasons for this result were not examined and therefore cannot be determined from the present data. Nevertheless, one hypothesis for future research is that students' academic use of AI may depend more strongly on instructional requirements, opportunities, and guidance than on the competence-related factor alone.

A further hypothesis, informed by previous research, is that concerns about the limitations and challenges of AI technologies may influence students' willingness to use such tools for academic purposes. The present study did not directly assess these concerns; however, previous studies have highlighted concerns regarding the reliability of AI-generated content, as well as ethical considerations, academic integrity, and the responsible use of AI in educational settings (Mao et al., 2023; Han et al., 2025). Research has also shown that the quality and accuracy of AI-generated responses may vary considerably depending on the task, context, and domain. For example, Getenet (2024) found that ChatGPT occasionally produced incorrect or pedagogically inappropriate solutions to mathematical problems, while Svičević et al. (2025) reported substantial differences in the performance of AI tools across mathematical domains, task formats, and languages. Such concerns could contribute to a more cautious approach to the use of academic AI, although this possibility should be examined directly in future research.

The findings of this study have important implications for educational practice. As AI technologies become increasingly prevalent in educational settings, teacher education programs should provide future educators with structured opportunities to critically evaluate, use responsibly, and pedagogically integrate AI tools into teaching and learning. Such opportunities may include dedicated training in AI literacy, AI-driven instructional design, and practical classroom applications. In this regard, Mustafaoğlu and Alkan (2025) reported that pre-service teachers who participated in a structured AI training program viewed the experience positively and believed that it enhanced their preparedness to use AI in educational settings. Such initiatives may contribute not only to the development of AI-related competencies but also to a more informed and reflective use of AI in educational contexts. Preparing future teachers for the opportunities and challenges associated with AI is likely to become an increasingly important component of contemporary teacher education.

Several limitations of this study should be acknowledged. First, the findings are based on self-reported data, which may be subject to response biases and may not fully reflect participants' actual digital skills, objective AI knowledge, or actual patterns of AI tool use. Second, the study was conducted with a relatively small sample of students enrolled in primary teacher education programs in Serbia, which limits both the generalizability of the findings to other populations and educational contexts and the stability of the exploratory factor solution. The identified factor structure should therefore be examined in larger, more diverse, and independent samples. Third, the study employed a newly developed instrument. Although the findings provided initial evidence regarding its factor structure and internal consistency in the present sample, further psychometric evaluation is needed. Fourth, the cross-sectional design does not allow changes over time or causal relationships between the examined variables to be assessed. Moreover, the study did not directly examine the factors that may account for the observed patterns. Therefore, the explanations

proposed in the Discussion should be interpreted with caution and examined directly in future research.

Future research could include larger and more diverse samples, adopt longitudinal designs, and examine actual patterns of AI use in educational settings. Additionally, further studies could investigate the effects of targeted training, instructional guidance, and curriculum-based AI integration on students' competencies and use of AI technologies.

## 7. Conslusion

This study contributes to the literature by developing a concise instrument that jointly assesses teacher education students' perceived digital competence and basic AI understanding, as well as their reported use of AI tools for studying, and by providing initial evidence of its factor structure and internal consistency. By examining these two related but conceptually distinct dimensions within the Serbian teacher education context, the study also extends the geographical and contextual scope of research on future teachers' preparedness for AI-integrated education.

The findings indicate that participants reported relatively high levels of perceived digital competence and a basic understanding of AI, while their use of AI tools in academic activities was comparatively limited. No statistically significant differences were observed across years of study, and no statistically significant association was found between PDC-BAIU and AI tool use in the present sample. These results highlight the importance of examining perceived competence and reported use as distinct dimensions rather than assuming that higher self-perceived competence necessarily corresponds to more frequent academic use.

More broadly, the study underscores the role of teacher education programs in creating structured opportunities for future teachers to critically evaluate, ethically use, and pedagogically integrate AI technologies. Further research with larger and more diverse samples is needed to further examine the proposed factor structure and determine how curricular integration, instructional guidance, and practical AI training influence students' digital and AI-related competencies and patterns of use.

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