What Do Teachers Think About AI? An Empirical Study Based on the TPU-AIED-Q

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Abstract. *This study investigates Brazilian teachers' perceptions of Artificial Intelligence (AI) in education using the TPU-AIED-Q instrument. Results from 143 respondents show generally positive attitudes, especially regarding AI's impact on educational practices. Moderate concerns about ethical risks and limited AI knowledge were also observed. No significant differences were found across gender, institution type, age, or experience. The findings highlight the need for inclusive teacher training and policy initiatives to support critical and informed AI integration in schools.*

1. Introduction

Integrating Artificial Intelligence (AI) into education has gained significant momentum over the past decade, promising to revolutionize how teachers teach and students learn. AI applications in education include intelligent tutoring systems, automated grading, adaptive learning environments, and administrative support tools that aim to personalize instruction and increase efficiency [Luckin et al. 2016, Holmes et al. 2019]. As these technologies rapidly advance, they transform educational environments and challenge existing pedagogical practices and professional roles in schools.

Despite the growing presence of AI in classrooms, its successful adoption largely depends on teachers' perceptions and attitudes, who remain the primary agents of pedagogical implementation [Selwyn 2019, Aoun 2017]. Educators' beliefs about AI, ranging from optimistic anticipation to ethical concerns, can critically influence the effectiveness of AI integration and determine whether it supports or disrupts teaching and learning practices [Zawacki-Richter et al. 2019, Ertmer 1999]. As such, understanding teachers' perceptions of AI is essential not only for the development of teacher-centered technologies but also for the design of professional development and policy frameworks that align with educators' expectations and realities.

Much of the research on AI in education has focused on technological capabilities or student outcomes, often neglecting the voices of teachers [Guerino et al. 2024, Isotani et al. 2023]. In response to this gap, the TPU-AIED-Q (Teachers' Perception of the Use of AI in Education Questionnaire) was developed and psychometrically validated as an instrument to assess the multiple dimensions of teachers' perceptions, including

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their general attitudes, levels of knowledge, concerns, and perceived impacts of AI on educational practices [Silva 2025].

The present study builds upon this foundation by applying the TPU-AIED-Q in a real-world setting to empirically investigate the perceptions of Brazilian educators toward AI in education. By analyzing teachers' responses, this study seeks to answer the following research questions:

RQ1: What are the overall attitudes of teachers toward the use of AI in education?
RQ2: How do perceptions vary across demographic and professional variables such as age, gender and teaching experience?
RQ3: What implications do these perceptions have for teacher training and educational policy regarding AI?

Addressing these questions contributes to a more grounded and educator-informed understanding of AI integration in education. Furthermore, the results aim to inform the design of inclusive and responsive AI policies that reflect teachers' real concerns and potential for engagement.

The remainder of this article is organized as follows. Section 2 reviews the relevant literature and theoretical foundations concerning AI in education and teacher decision-making. Section 3 outlines the methodology, including details on the TPU-AIED-Q instrument and data collection procedures. Section 4 presents descriptive and inferential findings on teachers' perceptions of AI across four key dimensions. Section 5 interprets these results in light of current research and educational implications. Finally, Section 6 offers concluding reflections, limitations, and practical recommendations for policy and future research.

2. Theoretical Background

Artificial Intelligence (AI) is increasingly recognized as a transformative force in education, potentially personalizing learning, automating administrative tasks, and supporting data-driven decision-making in classrooms and school systems [Luckin et al. 2016, Holmes et al. 2019, Isotani et al. 2023]. As defined by Holmes *et al.*, AI in education refers to using machine learning algorithms, natural language processing, and intelligent systems to enhance teaching and learning processes [Holmes et al. 2019].

One of the most promising applications of AI in education is adaptive learning. These systems use student interaction data to adjust content delivery and pacing according to individual needs, improving engagement and learning outcomes [Pane et al. 2017]. In parallel, intelligent tutoring systems offer personalized feedback and scaffolding, mimicking human tutoring behavior [Alkhatlan and Kalita 2019, Veloso et al. 2023]. Furthermore, AI can assist educators by automating grading, identifying at-risk students, and facilitating administrative workflows [Siemens and Baker 2012].

However, integrating AI into education raises many pedagogical, ethical, and operational concerns. A central issue is a shift in the teacher's role: as AI assumes more instructional functions, teachers are expected to act as facilitators, mentors, and interpreters of AI-generated feedback [Selwyn 2019, Long and Magerko 2020]. This transformation demands technical competence and what [Long and Magerko 2020] term *AI literacy*,

or the ability to understand, evaluate, and interact critically with AI tools in educational contexts.

Ethical considerations are also paramount. The collection and use of large-scale educational data by AI systems raise questions about data privacy, algorithmic transparency, and student surveillance [West and Allen tion]. Moreover, concerns exist that over-reliance on AI could reduce human interaction, cultural misrepresentation, and technological determinism in teaching [Zawacki-Richter et al. 2019].

An additional layer of complexity is the digital divide [Isotani et al. 2023, Veloso et al. 2023]. AI implementation in under-resourced schools risks reinforcing educational inequalities if technological infrastructure, training, and support are not equitably distributed isotani2023aied, warschauer2010equity. As such, the deployment of AI must be accompanied by inclusive design and capacity-building efforts that prioritize the needs of marginalized communities.

In this context, teachers' perceptions are crucial. According to Ertmer [Ertmer 1999], teacher-related barriers, including beliefs, confidence, and attitudes, can significantly affect school technology integration. Theoretical models such as the Technology Acceptance Model (TAM) venkatesh2003user and the Unified Theory of Acceptance and Use of Technology (UTAUT) venkatesh2003user emphasize that perceived usefulness and ease of use are key determinants of user adoption, including among educators.

Despite the relevance of these frameworks, recent studies suggest that generic acceptance models may not fully capture the nuances of teacher perceptions regarding AI in education [Guerino et al. 2024]. Teachers' concerns are multidimensional, encompassing pedagogical efficacy, ethical implications, systemic support, and personal competence. Therefore, instruments like the TPU-AIED-Q were designed to account for this complexity, incorporating cognitive and affective dimensions of perception [Silva 2025].

By examining these perceptions, this study contributes to the literature on educational AI and addresses the practical need for context-sensitive, teacher-informed strategies for AI integration in schools.

3. Methodology

This section outlines the methodological approach adopted in this study, which aimed to empirically examine teachers' perceptions of artificial intelligence (AI) in education using the TPU-AIED-Q instrument. It begins by describing the structure and theoretical underpinnings of the questionnaire, followed by a detailed characterization of the participants, including demographic and professional variables. The data collection procedures are presented, including the sampling strategy and administration process. Finally, the statistical techniques employed for data analysis are described, including descriptive and inferential methods used to identify trends and differences across subgroups.

3.1. Instrument: TPU-AIED-Q

The instrument used in this study is the Teachers' Perception of the Use of AI in Education Questionnaire (TPU-AIED-Q), a psychometrically validated scale developed to assess educators' attitudes, concerns, knowledge, and perceived impacts of artificial intelligence in the educational context [Silva 2025]. The development of the instrument followed a

rigorous design process grounded in a comprehensive literature review and theoretical framework, ensuring both construct validity and contextual relevance.

The final version of the TPU-AIED-Q consists of 26 items (statements) organized into four dimensions, each reflecting a distinct component of teachers' perceptions of AI:

1. **General Perception and Potential of AI (CP1)** – This dimension captures overall attitudes and expectations toward AI, including perceived benefits and openness to its use in education. It includes 10 items (e.g., "AI has the potential to improve teaching quality") and demonstrated excellent internal consistency with a Cronbach's alpha of 0.953.
2. **Concerns and Disadvantages of AI (CP2)** – This factor encompasses ethical, social, and operational concerns such as data privacy, equity, and over-reliance on technology. It includes 9 items and yielded a Cronbach's alpha of 0.908.
3. **Knowledge and Understanding of AI (CP3)** – This dimension measures teachers' self-perceived familiarity with AI concepts and confidence in using related technologies. It comprises 5 items and reported a Cronbach's alpha of 0.902.
4. **Impact of AI on Educational Practices (CP4)** – This final dimension assesses how teachers perceive AI as influencing pedagogical and administrative tasks. It contains 2 items and produces a Cronbach's alpha of 0.877.

Each item is rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Factor analysis conducted during the instrument's validation confirmed the four-component structure using principal component analysis with varimax rotation. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.882, and Bartlett's Test of Sphericity was significant (χ^2 = 3500.21, $p < 0.001$), confirming the suitability of the data for factor analysis. The total variance explained by the four components was 68.04%.

The TPU-AIED-Q demonstrated excellent psychometric properties such as presented by [Silva 2025], with all components exceeding the minimum reliability thresholds and aligning with the theoretical constructs proposed during development. As such, it is a robust instrument for capturing the multidimensional nature of teachers' perceptions of AI in education.

3.2. Participants

The study's sample comprised 143 Brazilian teachers who voluntarily responded to the TPU-AIED-Q through an online survey. Participants were recruited using a convenience sampling strategy, leveraging professional networks, social media platforms, and messaging groups. Data collection occurred between June 28 and July 10, 2024. Participation was anonymous and voluntary, and no personally identifiable information was collected.

The sample represented a diverse group of educators across different regions of Brazil. In terms of gender, 51% of respondents identified as male and 49% as female. Regarding institutional affiliation, 82.5% of teachers reported working primarily in public schools, while 17.5% were affiliated with private institutions.

The age distribution of respondents was as follows: 19.6% were between 25 and 34 years old, 37.8% between 35 and 44, 28.0% between 45 and 54, 11.2% between 55

and 64, 2.8% were 65 or older, and only 0.7% were under 25. This indicates that the sample was predominantly composed of mid-career and senior educators.

Teaching experience varied across participants: 40.6% reported more than 20 years in the profession, 17.5% had 11–15 years, 14.7% had 16–20 years, 14.0% had 6–10 years, 11.9% had 1–5 years, and 1.4% had less than 1 year of experience. This diversity provides a comprehensive overview of how perceptions of AI may vary with experience.

As for academic qualifications, 34.3% held a postgraduate specialization (lato sensu), 31.5% had a master's degree, 16.8% had a doctoral degree, 15.4% held a bachelor's degree, and 2.1% were still pursuing their undergraduate studies. This educational profile reflects a well-qualified teaching body, potentially contributing to more nuanced and informed responses regarding AI in education.

Participants were also asked about the primary educational level they teach. The responses included early childhood education, elementary (primary) and secondary levels, with a concentration in middle and high school teaching. Additionally, geographic representation spanned multiple Brazilian regions, with higher concentrations in the Northeast and Southeast, though all five macroregions were represented to varying extents.

This heterogeneous sample allows for meaningful subgroup analyses. It enhances the ecological validity of the findings, making them more relevant for informing AI-related policies and professional development initiatives across Brazil's educational systems.

3.3. Data Collection and Analysis

Data were collected using an online survey hosted on a secure platform, distributed via institutional mailing lists, educator groups on WhatsApp and Telegram, and professional social media networks. The survey included the full 26-item version of the TPU-AIED-Q, demographic questions, and a multiple-choice Likert-type scale. The Likert-scale items were coded numerically from 1 (strongly disagree) to 5 (strongly agree) for analysis.

Before statistical analysis, the dataset was screened for missing values and outliers. Incomplete responses were excluded, and Likert-scale items were reverse-coded when necessary to maintain a consistent directionality of scores. Descriptive statistics (means, medians, standard deviations) were calculated for each item and factor to provide a general overview of the distribution of responses across the sample.

Inferential analyses explored whether teacher perceptions varied across demographic or professional variables. Independent-samples t-tests were used to compare perception scores between two groups (e.g., public vs. private sector, male vs. female). One-way analysis of variance (ANOVA) was applied for comparisons across multiple groups (e.g., age ranges, teaching experience).

These insights are integrated into the discussion section to enrich the interpretation of findings and suggest actionable recommendations.

4. Results

This section presents the main empirical findings derived from applying the TPU-AIED-Q to a diverse sample of Brazilian educators. The results are organized into two main

parts: descriptive statistics, which provide an overview of teachers' general attitudes and perceptions toward AI in education, and inferential analyses, which examine how these perceptions vary across demographic and professional subgroups. The presentation of results highlights patterns within each of the four theoretical dimensions of the instrument, supported by appropriate statistical metrics such as means, standard deviations, *t*-tests, ANOVA, and correlation coefficients. These findings serve as the empirical foundation for the interpretations and recommendations discussed in subsequent sections.

4.1. Descriptive Statistics

To address "[RQ1] What are the overall attitudes of teachers toward the use of AI in education?", we computed composite scores for each of the four theoretical dimensions of the TPU-AIED-Q. Each composite score was calculated as the mean of its respective items, and summary statistics are presented in Table 1.

Tabela 1. Descriptive Statistics for TPU-AIED-Q Dimensions

Dimension	Mean	Std. Dev.	Min	Max
CP1: General Perception and Potential of AI	3.76	0.90	1.00	5.00
CP2: Concerns and Disadvantages of AI	3.48	0.86	1.11	5.00
CP3: Knowledge and Understanding of AI	3.66	0.90	1.00	5.00
CP4: Impact of AI on Educational Practices	3.89	0.90	1.00	5.00

The descriptive results suggest that teachers generally perceive AI in education positively. The highest mean score was observed in CP4, related to the perceived impact of AI on educational practices (mean = 3.89), indicating that most respondents recognize the usefulness of AI in improving administrative and instructional processes. CP1, which reflects overall perception and optimism about AI's potential, also scored relatively high (mean = 3.76), reinforcing that educators are open to AI-based innovation in schools.

Interestingly, CP3 (knowledge and understanding of AI) received a mean of 3.66, suggesting that while teachers are moderately confident in their familiarity with AI concepts, there remains room for growth in technical competence and conceptual clarity. CP2, reflecting concerns and perceived disadvantages, had the lowest mean (3.48), but still above the scale midpoint. This shows that teachers recognize limitations and risks, such as ethical issues and overdependence, but are not predominantly opposed to AI adoption.

These results comprehensively answer RQ1: teachers view AI in education with cautious optimism. They acknowledge its potential, report moderately high self-perceived understanding, and maintain awareness of important challenges. These findings underscore the need for nuanced policies and training programs to build teacher capacity while addressing ethical and pedagogical concerns.

4.2. Inferential Analyses

To address "[RQ2] How do perceptions vary across demographic and professional variables such as age, gender, teaching experience, region, and type of institution?", we conducted group comparisons using independent-samples *t*-tests (for binary variables such

as gender and institution type) and one-way ANOVA (for multi-category variables such as age groups and teaching experience). Table 2 summarizes the findings for each of the four dimensions of the TPU-AIED-Q.

Tabela 2. Statistical Test Results by Group and TPU-AIED-Q Dimension

Group	Comparison	Dimension	Mean G1	Mean G2	Test	p-value
Gender	Female vs Male	CP1	3.67	3.83	t-test	0.376
Gender	Female vs Male	CP2	3.46	3.51	t-test	0.787
Gender	Female vs Male	CP3	3.68	3.64	t-test	0.811
Gender	Female vs Male	CP4	3.81	3.96	t-test	0.371
Institution	Public vs Private	CP1	3.80	3.58	t-test	0.330
Institution	Public vs Private	CP2	3.50	3.44	t-test	0.789
Institution	Public vs Private	CP3	3.67	3.64	t-test	0.898
Institution	Public vs Private	CP4	3.89	3.88	t-test	0.976
Age	All Age Groups	CP1	3.60	4.00	ANOVA	0.313
Age	All Age Groups	CP2	3.30	3.76	ANOVA	0.085
Age	All Age Groups	CP3	3.40	4.00	ANOVA	0.150
Age	All Age Groups	CP4	3.58	4.20	ANOVA	0.152
Experience	All Experience Levels	CP1	3.56	4.06	ANOVA	0.212
Experience	All Experience Levels	CP2	3.29	3.73	ANOVA	0.249
Experience	All Experience Levels	CP3	3.44	4.00	ANOVA	0.131
Experience	All Experience Levels	CP4	3.62	4.23	ANOVA	0.112

No statistically significant differences were observed between groups at the $p < 0.05$ threshold across the four dimensions. While mean scores varied slightly, especially in perceptions related to age and experience, these differences did not reach significance. For example, male teachers reported higher CP1 (General Perception of AI). Still, again than female teachers (3.83 vs. 3.67), and public school teachers rated AI more positively than private school counterparts (3.80 vs. 3.58), but both differences were not statistically significant ($p > 0.33$).

ANOVA results showed that older and more experienced teachers tended to report slightly higher perceptions of AI's potential impact (CP1 and CP4) and lower levels of concern (CP2). Still, again, these trends were not statistically significant. The p-value closest to significance was for CP2 across age groups ($p = 0.085$), suggesting that meaningful group differences might emerge with a larger sample.

In summary, the inferential analysis suggests that perceptions of AI in education, while generally positive, are relatively consistent across demographic and professional subgroups. These findings reinforce the robustness of the TPU-AIED-Q and support the view that attitudes toward AI are broadly shared across the teaching population, providing a full empirical answer to RQ2.

5. Discussion

The findings of this study provide important insights into how teachers perceive the integration of artificial intelligence in education and offer guidance for the development of

policies and professional learning initiatives, answering RQ3. The overall results indicate that educators hold a cautiously optimistic view of AI, as reflected in high mean scores for both the perceived impact on educational practices (CP4) and the general potential of AI (CP1). These results confirm prior research suggesting that teachers are open to adopting new technologies, provided they are well-informed, supported, and contextually relevant zawacki2019systematic, selwyn2019robots.

At the same time, the moderate scores observed in CP2 (Concerns and Disadvantages of AI) and CP3 (Knowledge and Understanding of AI) highlight key areas of caution and potential resistance. Teachers express concern about ethical issues, data privacy, and the risk of over-reliance on automated systems, echoing global debates about the responsible use of AI in education west2019role, long2020literacy. Additionally, the relatively modest self-assessment of AI knowledge suggests that many educators feel underprepared to engage critically and competently with these technologies in their daily practice.

From a policy and professional development perspective, these findings emphasize the need for targeted investment in teacher education beyond mere technical training. Effective capacity-building programs should incorporate ethical reasoning, pedagogical integration strategies, and critical AI literacy, empowering teachers to evaluate, adapt, and advocate for appropriate uses of AI in diverse educational contexts.

Interestingly, the inferential analyses revealed no statistically significant differences across gender, institutional affiliation, age group, or teaching experience. This homogeneity suggests that the challenges and opportunities posed by AI are perceived similarly across different segments of the teaching population, reinforcing the universality of the need for inclusive and system-wide strategies. However, near-significant trends in CP2 across age groups indicate that more experienced teachers may express greater concerns, underscoring the importance of differentiated support for veteran educators.

Taken together, this study's results support the idea that teachers are not passive recipients of AI technologies but rather critical stakeholders whose perspectives must shape the direction of educational innovation. Policies that ignore teacher voices risk technological rejection, misuse, or inequitable implementation. Conversely, AI integration efforts that are co-designed with educators and responsive to their beliefs and experiences are more likely to succeed in transforming learning environments in meaningful and sustainable ways.

6. Final Remarks

This study aimed to investigate teachers' perceptions of artificial intelligence (AI) in education using the validated TPU-AIED-Q instrument. The findings offer a multidimensional perspective on how educators view AI's potential, limitations, and relevance for their professional practice.

The results demonstrate that Brazilian teachers express a balanced and thoughtful stance toward AI in education. On the one hand, they recognize its promise for enhancing pedagogical and administrative processes (CP4) and generally hold favorable attitudes toward its implementation (CP1). On the other hand, concerns about ethical implications and a moderate sense of self-efficacy regarding AI use (CP2 and CP3) reveal critical

awareness and a demand for deeper engagement with the topic. Importantly, inferential analyses showed no statistically significant variation in perception across gender, type of institution, age group, or teaching experience, suggesting a shared baseline of perception among educators.

However, the study's conclusions must be interpreted cautiously because a convenience sampling strategy was used. Participants were recruited through online platforms and professional networks, which may introduce self-selection bias. Although the sample includes teachers from diverse regions and backgrounds, it may not fully represent the broader population of Brazilian educators. Future studies should aim to expand the sample using probabilistic or stratified sampling methods to enhance generalizability.

Building on these findings, we propose two directions for future research. First, longitudinal studies should be conducted to monitor how teachers' perceptions evolve as they gain exposure to AI tools and professional development initiatives. Second, cross-national comparative studies would help identify cultural, structural, and policy-related factors that shape AI adoption in education globally, allowing researchers and policymakers to learn from diverse implementation contexts.

Based on the evidence presented, we recommend that ministries of education, school systems, and training institutions prioritize the following:

- Develop and implement AI-focused teacher professional development programs that combine technical, ethical, and pedagogical components.
- Involve teachers in designing and evaluating AI-based educational technologies to ensure contextual alignment and usability.
- Establish ethical and legal frameworks for using AI in schools, with clear data protection, transparency, and equity guidelines.
- Promote open dialogue across schools and communities to demystify AI and foster informed debate about its educational role.

In summary, teachers are central actors in the educational process and essential allies in AI's ethical and practical integration. Recognizing and acting upon their perceptions is necessary to build future-ready and equitable learning environments.

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