JTDED
Journal of Teacher Development and Education

Journal of Teacher Development and Education
3(2), 120-135,
ISSN: 3023-5081
https://journalted.com/
DOI: 10.29329/journalted.54
Received: 12/09/2025
Revised: 06/10/2025
Accepted: 18/10/2025

Utilization of ChatGPT in educational environmental research: Assessing teachers' evaluation skills on AI-generated data for educational environmental research

RESEARCH ARTICLE OPEN ACCESS

Maria Christoforaki[1c], **Mavrikaki Evangelia**[1], **and Galani Apostolia**[1]

[1] National and Kapodistrian University of Athens
c **Corresponding Author:** National and Kapodistrian University of Athens; **E-mail:** mchrst@primedu.uoa.gr

Article Info

Keywords
AI-generated data,
Digital literacy,
Evaluation, Skills,
Teachers.

Highlights:

- Investigates teachers' skills in evaluating AI-generated information on climate-related educational content.
- Uses pre- and post-quantitative design with training intervention to measure evaluative improvements.
- Training enhanced teachers' ability to assess the validity, reliability, and relevance of AI-generated data.
- Findings highlight the need for professional development to strengthen digital and environmental literacy in education.

Abstract

The increasing use of Artificial Intelligence (AI) in education presents new challenges, particularly in evaluating the credibility of AI-generated content. This study explores the attitudes and evaluative skills of 279 in-service primary and secondary teachers in assessing AI-generated information on urban heatwaves, as a climate-related issue. Using a quantitative pre-and-post design, data were collected through a digital questionnaire administered before and after a targeted training intervention. The instrument, informed by the CRAAP test, assessed teachers' ability to critically appraise AI-generated content. Findings revealed initial concerns about students' reliance on AI and difficulties in evaluating the validity and reliability of AI-generated data. Post-training results demonstrated marked improvements in participants' evaluative competencies across all CRAAP dimensions, particularly in assessing the currency and relevance of AI-generated content. These outcomes underscore the effectiveness of targeted training and reinforce the ongoing need to strengthen digital and data literacy among educators.

Cite: Christoforaki, M., Mavrikaki, E., & Galani, A. (2025). Utilization of ChatGPT in educational environmental research: Assessing teachers' evaluation skills on AI-generated data for educational environmental research. *Journal of Teacher Development and Education, 3*(2), 120-135 https://doi.org/10.29329/journalted.54

INTRODUCTION

The proliferation of generative artificial intelligence (AI), including large language models (LLMs), is profoundly reshaping the epistemic landscape of education. These technologies hold considerable potential for synthesizing information and generating content efficiently; yet, their integration into knowledge-intensive domains such as environmental education, where socio-scientific issues (SSIs) like climate change and urban heatwaves demand both accuracy and critical reasoning, reveals inherent tensions between AI-driven efficiencies and established epistemic standards. Generative systems produce fluent, coherent outputs, yet operate through opaque mechanisms that obscure methodological transparency, data provenance, and empirical grounding. Consequently, educators must navigate a paradox: outputs that appear authoritative may lack verifiable origins, challenging assumptions about trust and rigor in knowledge construction (Naqvi et al., 2025).

This opacity is compounded by the "black box" nature of AI, which severs the link between conclusions and their underlying justifications. Traditional educational epistemologies emphasize not only what is known but also how knowledge is generated, fostering critical inquiry into assumptions, biases, and methodological processes. Generative AI disrupts this principle by privileging surface-level fluency over deeper validation, a dynamic that can inadvertently foster epistemic complacency among both teachers and learners (Selvarajan, 2025).

Further complicating this landscape is the phenomenon of AI hallucination, wherein systems produce plausible yet factually ungrounded claims. Such outputs underscore tensions between validity, the extent to which information accurately represents the phenomenon under study, and reliability, the consistency of outputs across repeated evaluations. In domains such as educational environmental research, where empirical precision is non-negotiable, hallucinations risk conflating linguistic sophistication with factual accuracy, potentially misleading both educators and students. Addressing these challenges requires a reconceptualization of credibility in AI-generated content, emphasizing evidence grounding, methodological auditability, and alignment with established scientific and educational frameworks (Wibawa et al., 2024). Taken together, these considerations highlight the critical need to examine how teachers engage with, evaluate, and integrate AI-generated information, particularly in complex socio-scientific contexts of educational environmental research. Understanding these dynamics is essential not only for fostering accurate and reflective environmental education but also for supporting the development of teachers' critical and evaluative capacities in an era of rapidly evolving AI technologies.

Utilization of AI-generated data in educational environmental research

Addressing these challenges requires renegotiating the "epistemic contract" between educators, learners, and AI systems. The integration of AI into educational environmental research represents a paradigm shift in how learners engage with socio-environmental issues such as urban heatwaves and climate change. These complex, open-ended challenges demand not only scientific literacy, but also evidence evaluation, interdisciplinary synthesis, and ethical reasoning, skills that AI-generated content can scaffold, yet risks exacerbating if deployed without critical oversight (Nguyen et al., 2023; Bender et al., 2021).

AI's capacity to generate contextually rich examples and case studies can curate tailored case studies that integrate climatological, sociological, and economic data, enabling learners to grapple with issues adhered to educational environmental research in contextually rich scenarios (Dawson, 2021). Such applications align with the pedagogical shift toward "critical environmental education," which emphasizes interrogating the systemic roots of environmental crises and the ethical dimensions of technological solutions (Bozkurt et al., 2023). However, the effectiveness of AI-generated content hinges on its alignment with scientific validity and pedagogical intentionality. Studies reveal that AI tools often produce outputs that lack transparency in sourcing, with a tendency to present information in descriptively accurate but emotionally neutral language, potentially desensitizing learners to the urgency of valid research and environmental action (Strubell et al., 2020).

Teachers' AI literacy and evaluation skills

The integration of generative AI into educational environmental research underscores an urgent need for teacher training programs that address both the transformative potential and the epistemic risks of AI-generated content (Nguyen et al., 2023; Bozkurt et al., 2023). As LLMs increasingly mediate the creation of climate simulations, environmental analyses, and interdisciplinary case studies, educators must develop specialized competencies to critically evaluate these outputs while fostering scientific rigor and ethical accountability

(Dawson, 2021; Bender et al., 2021). This imperative arises from three interconnected challenges: (a) the epistemic opacity of AI systems, (b) the risks of biased or fabricated outputs, and (c) the pedagogical responsibility to align AI's efficiencies with educational environmental research's emphasis on evidence-based reasoning and socio-scientific literacy (Brown et al., 2022; Wu et al., 2022). These issues necessitate competencies in source interrogation, bias mitigation, and ethical reasoning (Bozkurt et al., 2023). Rather than emphasizing technical expertise in AI mechanics, professional development for teachers should focus on pedagogical adaptability, including: (a) strategies for interrogating sources and verifying claims, (b) techniques for recognizing and addressing AI "hallucinations" or biases, and (c) ways of integrating AI outputs into classroom activities without compromising scientific accuracy or ethical standards.

Within this broader imperative, the context of educational environmental research presents unique challenges and opportunities. Given the centrality of reliable information in addressing complex socio-environmental issues, the development of AI literacy among teachers becomes a matter of both epistemic and civic responsibility (Jemetz et al., 2025). Urban heatwaves exemplify such challenges, as they represent an intensifying climate-related phenomenon shaped by factors such as urban design, construction materials, vegetation, and socio-economic conditions (Cheng et al., 2018). Compared to other climate-related issues, urban heatwaves are especially relevant to primary and secondary education because of their immediate, tangible impacts on students' daily lives in urban settings, affecting health, mobility, energy consumption, and access to green spaces. Their local and visible nature makes them both accessible and meaningful for classroom inquiry, offering opportunities for students to connect global climate change with personal and community-level experiences. In this sense, urban heatwaves provide a particularly decisive context for developing students' scientific literacy and sense of responsible citizenship.

As educators and students increasingly rely on AI tools for information, the ability to critically evaluate AI-generated data becomes essential not only for fostering scientific literacy but also for cultivating responsible citizenship in an era of accelerating climate change. Within the existing literature, the notion of AI literacy has been framed as encompassing critical evaluation and ethical stewardship, positioning teachers as key actors in empowering students to both harness AI for innovation and safeguard against its risks (Bender et al., 2021; Oates & Johnson, 2025). However, despite these insights, a significant gap remains in research at the intersection of AI tool use and environmental education. While recent work has underscored the need to equip educators with competencies to assess AI-generated content critically, little is known about how such competencies can be meaningfully cultivated in the context of socio-environmental issues such as urban heatwaves.

In this paper, we aim to address both the opportunities and challenges of AI in education and examine how primary and secondary teachers develop the skills to evaluate AI-generated data related to environmental issues critically. In attempting to respond to this challenge, we designed a professional development intervention focused on strengthening teachers' capacity to recognize misinformation, interrogate the reliability of AI outputs, and integrate AI-generated data into their teaching of climate-related socio-environmental issues and especially urban heatwaves as an exemplary case study.

Framed within this focus, the study addressed the following research questions:

(a) What are primary and secondary school teachers' attitudes and perspectives on evaluating data generated by AI tools regarding urban heatwaves in the context of the climate crisis?
(b) To what extent can primary and secondary education teachers effectively evaluate the validity and reliability of AI-generated data concerning the example of urban heatwaves?
(c) To what extent does training in AI-assisted data evaluation improve teachers' skills to critically assess and utilize AI-generated information in their teaching of environmental socio-scientific issues such as urban heatwaves?
(d) How do teachers' self-reported attitudes correlate with their evaluative skills of AI-generated data on urban heatwaves in the context of the climate crisis?

METHOD

Sample

The study sample comprised 279 in-service primary and secondary school teachers from Greece, as detailed in Table 1.

Table 1. Description of the Sample

Variable	mean±SD	3.63 ± 1.02
Age	min-max	<25-55+
Gender	Male (N%)	19 (6.8%)
	Female (N%)	260 (93.2%)
Teaching educational Level	Elementary (N%)	222 (79.6%)
	Junior High School (N%)	35 (12.5%)
	High school (N%)	22 (7.9%)
Teaching Experiences	0-5 years (N%)	53 (19%)
	6-10 years (N%)	32 (11.5%)
	11-15 years (N%)	27 (9.7%)
	16+ years (N%)	167 (59.9%)
Previous AI Training	Yes (N%)	145 (52%)
	No (N%)	134 (48%)
Use of AI tools in teaching	Yes (N%)	169 (60.6%)
	No (N%)	110 (39.4%)
Used AI tools	ChatGPT (N%)	108 (38.7%)
	DeepSeek (N%)	7 (2.5%)
	Gemini (N%)	2 (0.7%)
	Other (N%)	82 (29.4%)
	Variation (ChatGPT + other) (N%)	81 (29.0%)

Tools

A mixed-methods pre–post research design was employed, using a digital questionnaire to investigate in-service teachers' attitudes and competencies regarding the validity and reliability of AI-generated data on urban heatwaves. It is important to clarify that in this study, validity refers to the extent to which AI-generated data accurately represent the phenomenon under study, whereas reliability refers to the consistency of these outputs across repeated evaluations. Teachers were asked to evaluate outputs from widely available AI tools (e.g., ChatGPT, DeepSeek, Gemini) to ensure ecological validity, as these tools represent those most accessible in classroom contexts. The questionnaire was developed through: (a) a review of relevant literature (Kong et al., 2024), and (b) insights from the ERASMUS+ KA2 project "HEATWAVES AWARENESS THROUGH ONLINE LEARNING" (https://heatwaves-project.eu/), which advocates for the application of the CRAAP test as an evaluative framework for the credibility and reliability of data sources.

The CRAAP test, comprising the dimensions of Currency, Relevance, Authority, Accuracy, and Purpose, was adopted as the core framework for assessing the quality of environmental data produced by AI. This framework provides a structured method for critically appraising information sources, emphasizing not only factual accuracy but also the broader context, authorship, and purpose of the data. Within the scope of this study, the CRAAP test was adapted for professional development purposes to support teachers in critically evaluating AI-generated content on urban heatwaves. This approach encouraged educators to assess not just the surface-level accuracy of information, but also its: (a) timeliness (Currency), (b) alignment with educational aims (Relevance), (c) source credibility (Authority), (d) content accuracy (Accuracy), and (e) the underlying intent behind the information (Purpose), as detailed in Table 2.

Table 2. CRAAP-Based Evaluation Rubric for Assessing AI-Generated Educational Content on Urban Heatwaves and Climate Change (Meriam Library, California State University, Chico, n.d.)

Dimension	1 (Very Low)	2 (Low)	3 (Moderate)	4 (High)	5 (Very High)
Currency	The content is outdated or undated, lacks any temporal context, and may contain	Dated content (3+ years old); minimal context indicating when data was generated.	Moderately current (1–3 years); some evidence of update or temporal reference.	Content is recent (within 1–2 years); the update information is	Very recent (within 12 months); all data is up-to-date with no broken links; reflects current climate science and policy.

	broken or irrelevant links.			clear and verifiable.	
Relevance	Content is off-topic or irrelevant to the urban heatwave theme; lacks instructional value.	Only loosely connected to urban heatwaves or climate education; too general or superficial.	Content is moderately relevant; it provides some value for teaching but lacks depth or clarity.	Supports specific teaching goals on urban heatwaves; offers structured educational value.	Highly aligned with the curriculum; provides depth, examples, and clear connections to learning outcomes.
Authority	No identifiable author or organization; unverified or questionable domain (e.g., personal blog).	The source lacks clear qualifications or affiliations and has limited evidence of expertise.	The author or source has some credibility, possibly linked to general educational or climate resources.	Authored by a recognized educator, academic, or organization; credible domain (.org, .edu).	Authored or endorsed by a recognized authority (e.g., university, government agency, peer-reviewed body); domain is .gov.
Accuracy	Content includes factual errors, misinformation, or grammar/spelling mistakes; lacks data support.	Some inaccuracies or vague/unsubstantiated claims; minimal referencing.	Mostly accurate; may lack citations but shows a reasonable level of correctness.	Factually sound with few errors; some evidence of data or expert sources.	Entirely accurate, well-researched, clearly cited, error-free, and aligned with established scientific understanding.
Purpose	Content is biased, promotional, or persuasive; it lacks transparency about intent.	Slightly biased or includes promotional language; unclear if intended for education.	Mostly informative but may include subtle bias or unbalanced perspectives.	Primarily informative and objective; minimal bias; supports learning.	Clear educational purpose; balanced, unbiased, and written to support critical thinking and research.

The questionnaire comprised 23 items. Seven items captured demographic variables information (e.g., age, gender, teaching experience), six items used a 5-point Likert scale (1 = Totally Disagree to 5 = Totally Agree) to gauge teachers' attitudes and perceptions regarding the use of AI-generated data on urban heatwaves, and ten items were designed to measure teachers' evaluation skills using a CRAAP-based 5-point Likert scale (1 = Very Low to 5 = Very High - Table 2). Before administering the questionnaire, teachers were given a concise, one-page version of the adapted CRAAP rubric which defined each dimension (Currency, Relevance, Authority, Accuracy, Purpose) and explained the 5-point scale (1 = Very Low to 5 = Very High). Providing the rubric up front ensured that all respondents shared a typical frame of reference when judging the AI-generated urban-heatwave content, thereby enhancing the instrument's content validity and the reliability of the resulting ratings. They were instructed to consult the rubric throughout the evaluation task, and brief reminders appeared at the start of each questionnaire section to reinforce consistent use of the criteria. The instrument's structure, subscales, and internal consistency metrics are presented in Table 3, with all reliability indices exceeding the acceptance level as defined by Nunnally (1978).

Table 3. The "Teachers' Evaluation Skills on AI-Generated Data Utilized in Educational Environmental Research "questionnaire's Subscales

Subscale	Cronbach's Alpha	Items
AI Attitude (A_I_A)	.822	6

CRAAP AI Skills (C_A_S)	.990	50*
Total	.986	56

*10 items multiplied with the 5 aspects of CRAAP test for each one

Two composite variables were derived from the questionnaire responses: Attitude about Artificial Intelligence (A_I_A) and CRAAP Artificial Intelligence Skills (C_A_S), calculated as the mean scores across the respective subscale items.

Attitude about Artificial Intelligence (A_I_A): This subscale evaluated teachers' self-reported views on incorporating AI-generated environmental data into their teaching practices, specifically in relation to urban heatwaves (Items B1–B6). Sample items included statements such as: "B3. I am concerned that the use of AI tools by students in my class to inform them about environmental issues such as urban heatwaves may reinforce their misconceptions."

CRAAP Artificial Intelligence Skills (C_A_S): This subscale focused on teachers' ability to assess the credibility and reliability of AI-generated content on climate-related urban heatwaves (Items C1–C10). Each item provided both a user prompt and a corresponding AI-generated response, requiring participants to evaluate the information based on CRAAP criteria. For example, "C1. According to a 2022 report by the Global Urban Climate Consortium (GUCC), urban areas can experience temperature increases of up to 7.3°C during heatwaves due to the urban heat island phenomenon. (Prompt: What is the impact of the urban heat island phenomenon on urban areas during heatwaves? Answer based on recent data. Source: ChatGPT)". Items included both factually valid and invalid AI-generated content, as categorized in Table 3. Notably, no reverse-coded items were included, ensuring consistency in data interpretation.

Table 4. Item Description of C_A_S Variable

Invalid and Unreliable Items	Valid and reliable Items
C1. According to a 2022 report by the Global Urban Climate Consortium (GUCC), urban areas could experience a temperature increase of up to 7.3°C during heat waves due to the urban heat island effect. (Prompt: What is the effect of the urban heat island effect on urban areas during heat waves? Answer based on recent data? Source: ChatGPT)	C2. Findings from the US National Oceanic and Atmospheric Administration (NOAA, 2018) suggest that urban heat waves last longer than those in rural areas due to the insulating properties of urban infrastructure. (Prompt: Provide a scientific statement about the duration of urban heat waves compared to rural ones, citing an authoritative source such as NOAA, Source: ChatGPT)
C4. Empirical evidence suggests a correlation between the increasing frequency of urban heat waves and broader climate change trends. (Prompt: What is the relationship between the increasing frequency of urban heat waves and climate change? Source: DeepSeek)	C3. Imhoff et al. (2010), in a study published in the Proceedings of the National Academy of Sciences, found that water-impermeable (impermeable) surfaces in urban areas contribute significantly to the increase in extreme temperatures during heat stress. (Prompt: Quoted findings from a study in a prestigious scientific journal on the effect of impermeable surfaces on extreme temperatures in cities, Source: DeepSeek)
C5.Data from the Historical Urban Climate Archive (HUCA, 2019) show that the frequency of urban heat waves has doubled in the last 50 years in major cities worldwide. (Prompt: quoted a statement with statistics from historical data showing the increase in urban heat waves in recent decades, Source: Gemini)	C8. The US Environmental Protection Agency (EPA, 2008) has stated that the urban heat island effect leads to an immediate need to provide cool and shaded spaces, which leads to significant financial costs. (Prompt: Provide a report from the EPA on how the urban heat island increases the need for cool spaces and the economic consequences of this need, Source: ChatGPT)
C6. A study conducted by the International Economic Climate Board (IECB, 2023) showed that urban heat waves cause annual economic losses of about $1.5 billion in metropolitan areas.	C9. According to Harlan et al. (2013) in the journal Environmental Health Perspectives, urban heat waves are associated with increased mortality or heat-related illnesses, especially in densely populated urban areas. (Prompt: Give a scientific statement from a 2013 publication on the public health impacts of urban heat

(Prompt: Provide a recent estimate of the annual economic losses caused by urban heat waves in metropolitan areas, Source: DeepSeek)	waves, focusing on mortality and disease, Source: ChatGPT)
C7. The Energy and Climate Research Association (ECRA, 2020) reported that urban heat waves lead to a 20% increase in energy consumption in urban areas. (Prompt: What is the impact of urban heat waves on energy consumption? Report on research from 2020 onwards, Source: Gemini)	-
C10. A 2020 study by the Center for Sustainable Urban Futures (CSUF) argues that green roofs on buildings and increased vegetation can reduce local temperatures in cities by an average of 3°C during heat waves. (Prompt: According to recent research findings, how can implementing green roofs and vegetation reduce temperatures in cities? Source: Gemini)	-

To evaluate the construct validity of the CRAAP-based instrument designed to measure teachers' skills in assessing AI-generated data, an exploratory factor analysis (EFA) was conducted separately for items representing valid and invalid content. The adequacy of the sample for factor analysis was confirmed through the Kaiser-Meyer-Olkin (KMO) measure, which yielded excellent values of 0.954 for valid items and 0.965 for invalid items, both well above the recommended threshold of 0.90. Additionally, Bartlett's Test of Sphericity indicated statistically significant deviations from the identity matrix for both item sets (valid: $\chi^2(210) = 7444.350$, $p < .001$; invalid: $\chi^2(435) = 10907.394$, $p < .001$), thereby confirming the suitability of the data for factor analysis.

Table 5. Exploratory Factor Analysis Across All Items of C_A_S Variable Pre-Training

Test Component	Valid Items	Invalid Items
Kaiser-Meyer-Olkin Measure	0.954	0.965
Bartlett's Test of Sphericity		
– Approx. Chi-Square	7444.350	10907.394
– Degrees of Freedom (df)	210	435
– Significance (Sig.)	.000	.000

To assess the stability of the CRAAP-based instrument's factor structure following the intervention, a confirmatory factor analysis (CFA) was conducted on the post-intervention dataset (n = 279). The model was specified based on the two-factor structure identified in the pre-intervention exploratory factor analysis (EFA), distinguishing between teachers' evaluative responses to valid and invalid AI-generated environmental information. The CFA model demonstrated an acceptable to good fit across multiple indices, as described in Table 5. All items loaded significantly onto their respective latent factors ($p < .001$), with standardized factor loadings ranging from 0.62 to 0.88 for the valid items factor, and from 0.59 to 0.85 for the invalid items factor. The two latent factors were moderately correlated ($r = 0.51$), suggesting that while they are conceptually related, they represent distinct dimensions of evaluative competence. These results support the structural validity of the CRAAP-based C_A_S instrument and indicate that the factor structure remained stable following the training. The findings reinforce the distinction between teachers' ability to assess the credibility of valid versus invalid AI-generated content and confirm that these skills can be meaningfully modeled as separate, but related constructs.

Table 6. Confirmatory Factor Analysis Across All Items of C_A_S Variable Post-Training

Fit Index / Parameter	Value
Model Fit Indices	
Chi-Square (χ^2, df = 349)	812.47***
Comparative Fit Index (CFI)	0.948
Tucker-Lewis Index (TLI)	0.939
Root Mean Square Error of Approximation (RMSEA)	0.061
90% CI for RMSEA	[0.054, 0.068]
Standardized Root Mean Square Residual (SRMR)	0.048

Standardized Factor Loadings	
Valid Items Factor	0.62 – 0.88
Invalid Items Factor	0.59 – 0.85
Latent Factor Correlation	
Valid ↔ Invalid Factors	0.51***

Stages of the research

The research was conducted in three distinct phases, aligned with a structured timeline:

Pre-training Phase (October 2023). Participants' baseline competencies in evaluating the validity and reliability of AI-generated data related to urban heatwaves were assessed, along with their attitudes toward the use of AI-generated data in educational environmental research. Data were collected over two weeks via a structured digital questionnaire distributed during the open call for participants in October 2023.

Training Phase (November 2023 – January 2024): Primary and secondary school teachers participated in a structured training program divided into three key parts, conducted over three months, facilitated through online sessions and classroom applications:

First Part (November 2023): During the first online session, teachers were introduced to criteria for evaluating the validity and reliability of data related to urban heatwaves, with a particular focus on AI-generated content. They engaged in structured activities to practice distinguishing factual, science-based information from misinformation. Teachers also developed skills in recognizing AI-generated content and crafting effective prompts to obtain accurate and relevant environmental information from AI tools.

Second Part (November – December 2023): Teachers implemented the strategies and activities introduced in Part I within their classrooms. With ongoing support from the program facilitators, they guided students in exploring environmental topics, such as urban heatwaves, using AI tools. This phase provided teachers with opportunities to strengthen further their ability to assess AI-generated content and formulate optimized prompts, while helping students critically engage with environmental information.

Third Part (January 2024): Drawing on their classroom experiences, teachers participated in a second online session focused on collaborative reflection. Working in small groups (4–5 members), they discussed the instructional approaches they had applied and shared insights on using AI tools to address urban heatwave issues. These discussions led to the identification and sharing of effective practices for fostering the critical use of AI in environmental education.

Post-training Phase (February – March 2024): The digital questionnaire was re-administered to evaluate the impact of the training on teachers' skills and attitudes, during February 2024, over a two-week period. This phase aimed to determine the extent to which the training program improved participants' ability to critically assess and apply AI-generated information in the context of socio-environmental issues such as urban heatwaves. Final reflections and project wrap-up occurred in March 2024.

RESULTS

Teachers' Self-Reported Attitudes and Perspectives on AI-Generated Data Regarding Urban Heatwaves

Pre-training

Most teachers (55.2%) expressed a neutral perspective on the reliability of information generated by AI tools (B1), whereas 34.8% agreed, indicating a moderate level of trust in the accuracy of such content. Regarding the verification of sources referenced by AI applications (B2), 39.8% of respondents affirmed that they routinely assess the credibility and timeliness of these citations. Nonetheless, uncertainty persisted concerning the potential for AI to reinforce students' misconceptions (B3), with over half of the participants (55.6%) adopting a neutral stance, implicating ambivalence. When asked about their ability to distinguish between AI-generated outputs and data derived from scholarly or scientific sources (B4), 28% acknowledged challenges in making such distinctions. Similarly, teachers reported limited confidence in verifying AI-generated statistics and visualizations (B5), with 39.1% responding neutrally and 39.7% expressing disagreement with the statement regarding their confidence in performing this task. Parallel concerns were noted regarding educators' capacity to teach students to critically

assess AI-produced environmental data (B6), with 39.4% of respondents neither agreeing nor disagreeing, reflecting considerable hesitancy or self-perceived limitations in pedagogical readiness.

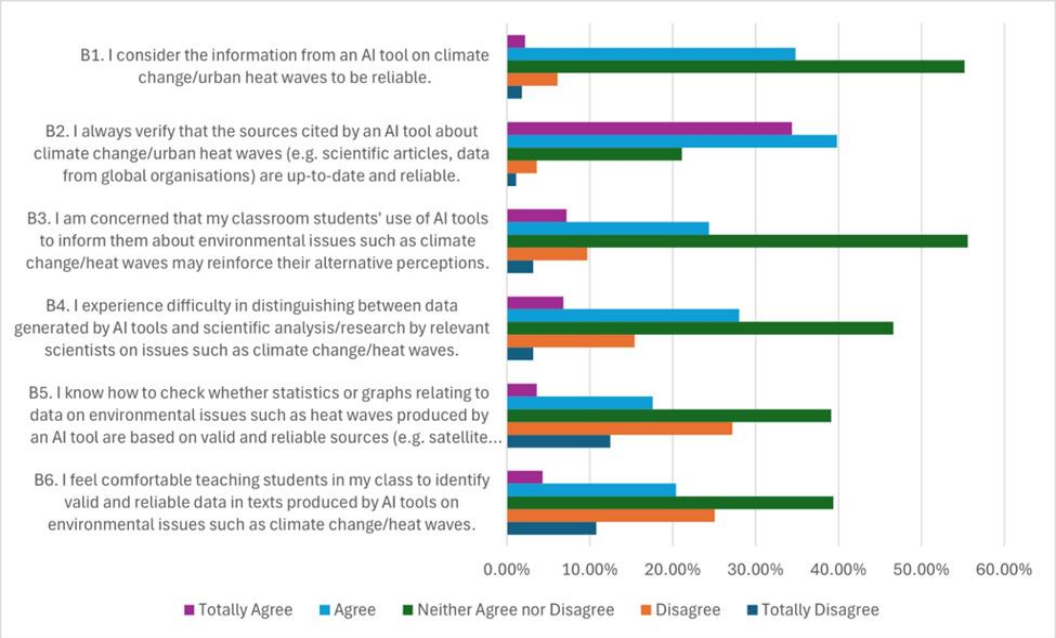

Figure 1. Teachers' Answers Regarding Their Self-reported Attitudes and Perspectives on Evaluating AI-Generated Data

Post-training

Following the training, teachers' perceptions showed noticeable changes. Regarding the perceived reliability of AI-generated information (B1), responses indicated increased confidence, with 45% agreeing and 11% strongly agreeing that such information is reliable, while neutrality decreased to 40%. Concerning the verification of the validity and currency of sources cited by AI tools (B2), 45% agreed that they regularly engage in this practice, suggesting a stronger commitment to assessing sources. When it comes to distinguishing AI-generated content from scientific data (B4), 39% agreed that they find it challenging, showing that although awareness of the difficulty remains, more teachers now recognize the complexity involved. Notably, confidence in evaluating AI-generated statistics and visual data (B5) improved, with 38% agreeing and 14% strongly agreeing that they have the necessary skills. A similar trend was seen in responses to teaching students how to assess such data (B6), where 38% felt comfortable in this instructional role, marking a significant decrease in neutral responses compared to pre-training levels.

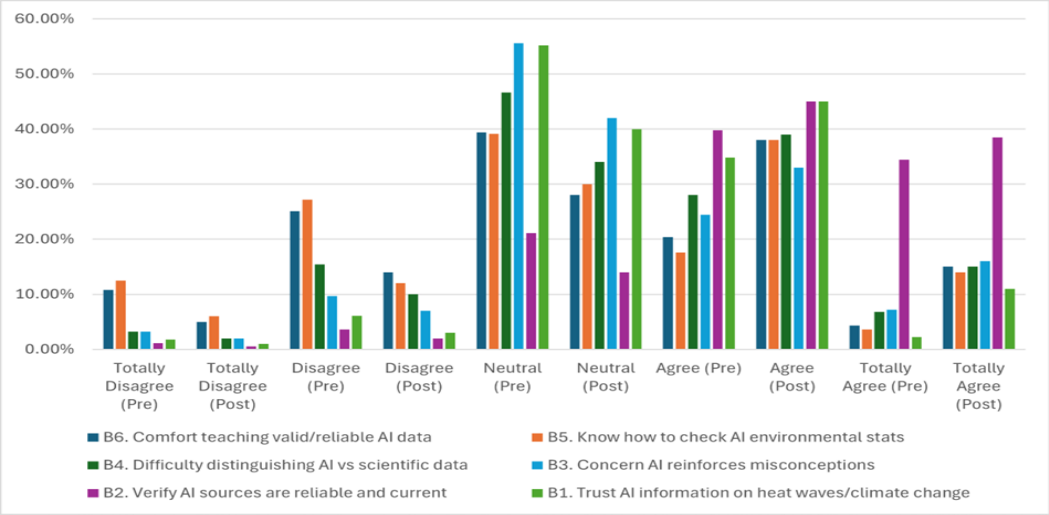

Figure 2. Post-Training Teachers' Answers Regarding their Self-reported Attitudes and Perspectives on Evaluating AI-Generated Data

Teachers' evaluating skills of AI-generated data on urban heatwaves based on the CRAAP Test

Pre-training

Evaluation of AI-generated environmental content using the CRAAP (Currency, Relevance, Authority, Accuracy, and Purpose) framework revealed a general pattern of moderate to moderately favorable assessments, reflecting teachers' critical engagement with both valid and less reliable AI-generated environmental data.

Currency: Participants generally perceived AI-generated information as reasonably current. Across both valid and invalid items, most responses clustered around moderate (35.8%–42.3%) and high (19.4%–25.1%) ratings. Very high ratings remained less frequent (8.6%–13.3%), and low or very low ratings rarely exceeded 25%. Notably, valid items such as C2 and C9 had slightly higher ratings for currency, suggesting educators recognized the temporal relevance of more credible content. Meanwhile, invalid items (e.g., C1, C5) received marginally more neutral or low responses, indicating some sensitivity to outdated or questionable claims.

Relevance: Relevance ratings followed a similar trend, with the majority of responses falling into the moderate (37.6%–44.1%) and high (19.7%–26.9%) ranges. Valid items, particularly C2 and C3, showed a higher proportion of high and very high relevance ratings (up to 26.9%), indicating that teachers found these materials well-aligned with educational contexts. In contrast, some invalid items received more neutral responses, suggesting that content quality influenced perceived applicability in instructional settings.

Authority: When evaluating authority, participants demonstrated caution. Moderate ratings (40.5%–47.2%) dominated both valid and invalid items, with high ratings ranging from 17.6% to 26.9%. Valid items like C2 and C9 tended to receive slightly higher ratings and fewer low ones, reflecting stronger perceived credibility. In contrast, invalid items (e.g., C6, C7) were more often rated as moderate or low in authority, highlighting teachers' developing ability to differentiate between credible and non-credible sources.

Accuracy: Responses to accuracy showed a balanced yet critical perspective. Most items, regardless of validity, received moderate (36.9%–46.6%) or high (15.4%–25.4%) ratings. However, valid items like C9 had the highest combined ratings in the high and very high categories (up to 25.4%), suggesting participants were better able to identify factual consistency in more reliable content. Invalid items (e.g., C4, C6) received more moderate and low ratings, indicating some recognition of factual inaccuracies.

Purpose: Perceptions of purpose were relatively consistent, with moderate ratings (41.2%–44.4%) prevailing and high ratings between 19.0% and 25.1%. Valid items such as C8 and C9 showed slightly stronger scores in transparency of intent, though differences across all items were generally minor. Occasional concerns regarding bias or unclear intent persisted, especially among the invalid items, but overall, teachers appeared to view most AI-generated content as generally transparent.

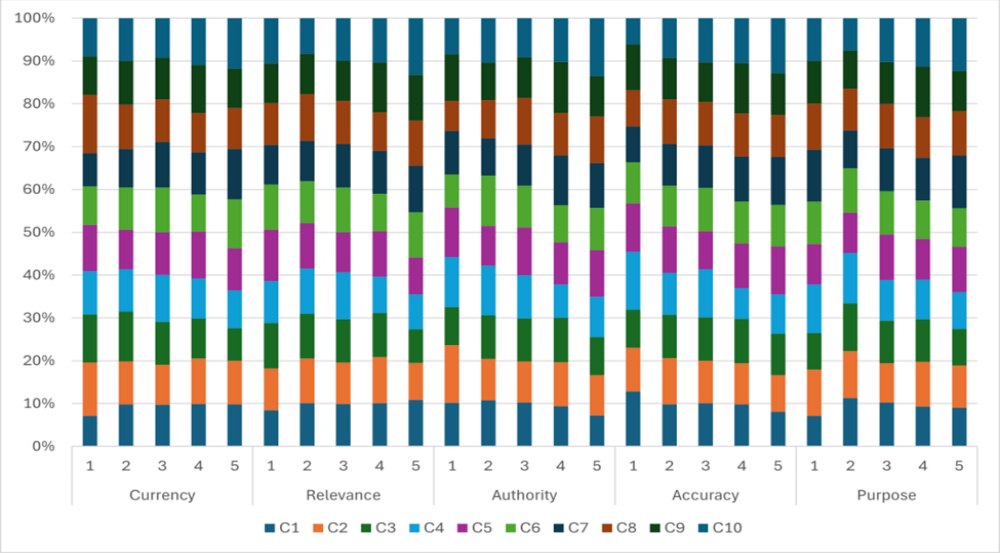

Figure 3. Teachers' Answers Regarding their Evaluation on AI Generated Data about Urban Heatwaves Based on CRAAP Test

Post-training

The post-training results illustrate a substantive enhancement in educators' evaluative capabilities across all five dimensions of the CRAAP framework. The pronounced improvements in assessments of authority and accuracy, particularly for valid items, signal a deepened critical literacy in engaging with AI-generated content. These findings affirm the value of targeted professional development in equipping educators with the analytical tools necessary to navigate an evolving informational landscape marked by increasing algorithmic mediation.

Currency: Post-training data revealed a discernible enhancement in participants' ability to appraise the temporal relevance of AI-generated content. Valid items (C2, C3, C8, and C9) exhibited substantial increases in high (34.0%–37.0%) and very high (17.0%–18.0%) ratings, while low and very low assessments remained consistently below 18%. This shift indicates that participants became more attuned to the recency of information, particularly when engaging with content of demonstrable validity. Although similar trends emerged across invalid items, the more pronounced gains for valid sources suggest that the intervention effectively cultivated participants' capacity to discern timely and up-to-date information within a digital context.

Relevance: Participants demonstrated a heightened ability to evaluate the contextual suitability of AI-generated materials for pedagogical or informational purposes. Valid items received consistently strong ratings, with high and very high responses ranging from 38.0% to 39.5% and 14.0% to 16.0%, respectively. These results suggest that educators were increasingly able to recognize content that aligned with instructional objectives and learner needs. While some improvements were also evident for invalid items, the consistently superior evaluations attributed to valid content underscore a more sophisticated understanding of contextual relevance post-training.

Authority: The dimension of authority witnessed a notable refinement in participant judgments, particularly concerning the credibility and trustworthiness of AI-generated content. Valid items such as C3, C8, and C9 saw increases in high (up to 39.0%) and very high (up to 16.0%) ratings. This reflects an elevated critical awareness of the provenance of information, including considerations of authorship, institutional affiliation, and expertise. Although invalid items also experienced modest improvements, the disparity between valid and invalid ratings highlights participants' improved discernment regarding the legitimacy of informational sources following the instructional intervention.

Accuracy: This emerged as one of the domains with the most pronounced post-training gains. Valid items demonstrated significant growth in both high (up to 39.5%) and very high (up to 15.5%) evaluations, suggesting that participants developed a more nuanced ability to detect factual consistency, logical coherence, and evidence-based reasoning in AI-generated outputs. These findings indicate that the training enhanced participants' capacity to critically assess content's veracity, particularly distinguishing between credible and potentially misleading information. Although accuracy ratings for invalid items also improved, the more robust endorsement of valid content reinforces the efficacy of the intervention in promoting analytical rigor.

Purpose: Assessments of the intended purpose behind AI-generated information became increasingly favorable and nuanced. Valid items garnered high and very high ratings between 37.0% - 38.0% and 14.5% - 17.5%, reflecting a more substantial capacity among participants to detect transparency of intent and to identify potential bias or manipulative undertones. Although improvements were noted across both valid and invalid items, the elevated ratings for valid content suggest that participants became more discerning in their evaluation of communicative intent and ethical implications.

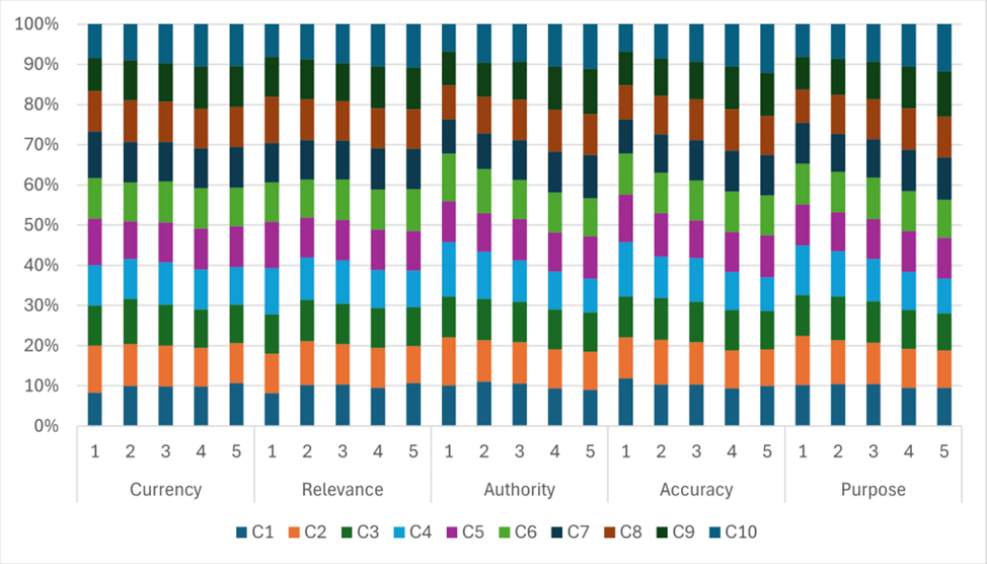

Figure 4. Post-Training Teachers' Answers Regarding their Evaluation of AI-Generated Data about Urban Heatwaves Based on The CRAAP Test

Correlation Between Attitude and Evaluative Skills

A Pearson correlation analysis was conducted to examine the association between educators' attitudes toward AI-generated environmental data and their evaluative competencies. Specifically, the study examined the relationship between participants' attitudinal orientation toward the use of AI-generated content (A_I_A) and their self-reported ability to assess its quality based on the CRAAP criteria (C_A_S). The results indicated a statistically significant, though weak, positive correlation between the two variables ($r = 0.206$, $p = .001$, $n = 267$). This finding suggests that educators who demonstrated greater openness to AI-generated data also reported slightly higher levels of competence in evaluating the credibility, relevance, and accuracy of such information. Although the strength of the association is limited, its statistical significance highlights the potential role of attitudinal factors in shaping educators' critical engagement with AI-generated content, implying that a more favorable disposition toward AI may modestly contribute to enhanced evaluative proficiency

Following the training intervention, a second Pearson correlation analysis was performed to assess whether the relationship between attitudes toward AI-generated data (A_I_A) and evaluative competencies (C_A_S) had changed. The post-intervention results revealed a statistically significant, albeit still modest, positive correlation between A_I_A and C_A_S ($r = 0.256$, $p = .001$, $n = 279$). This slight increase compared to pre-intervention levels suggests that the training may have facilitated a more substantial alignment between participants' attitudinal openness to AI and their capacity to critically assess AI-generated environmental information. While the correlation remains moderate, its statistical significance points to a meaningful improvement in the integration of attitudinal and skill-based dimensions of AI literacy among educators.

Table 7. Pre-And Post-Training Correlation of Teachers' Attitude and Skills on Evaluating AI-Generated Data on Urban Heatwaves*

	Pre-Training		Post-Training	
	A_I_A	**C_A_S**	**A_I_A**	**C_A_S**
Attitudes toward AI (A_I_A)	1.000	.206**	1.000	.256**
Evaluation Skills (C_A_S)	.206**	1.000	.256**	1.000
Sig. (2-tailed)	—	.001	—	.001
N	279	267	279	267

*The difference in sample size (N) between Attitudes toward AI (A_I_A) and Evaluation Skills (C_A_S) in the Pre-Training and Post-Training sections reflects missing responses for the C_A_S measure. All available data were used for each variable

DISCUSSION

This study examined how in-service primary and secondary teachers engage with, evaluate, and integrate AI-generated data within the context of heatwave education. Building on the premise that climate change education must be grounded in both scientific accuracy and digital literacy, the study assessed teachers' attitudes and evaluative skills related to AI-generated textual data. As AI tools increasingly shape how environmental information is introduced in classrooms, understanding educators' evaluative capacities becomes essential, not only to prevent the dissemination of misinformation but also to promote evidence-based and critically informed teaching practices. The findings are discussed here with particular attention to teachers' attitudes, their application of the CRAAP framework, and the impact of targeted training on their ability to differentiate valid from misleading information.

The observed spectrum of teachers' attitudes toward AI-driven environmental information suggests a cautious engagement with emerging technologies. While over half of participants adopted a neutral stance regarding the reliability of AI-generated data and roughly one-third expressed agreement, these patterns indicate a tentative optimism tempered by uncertainty. Such hesitancy aligns with prior research documenting educators' concerns about the accuracy and potential biases of AI outputs (Zawacki-Richter et al., 2019). Concerns about pedagogical implications were similarly evident, as participants acknowledged that AI might inadvertently reinforce student misconceptions, highlighting the challenges of uncritical AI adoption in complex, value-laden contexts such as climate change education (Selwyn, 2019). Furthermore, the difficulty some teachers report in distinguishing AI-generated content from empirically validated scientific data highlights persistent gaps in data literacy, which are consistent with documented challenges in teaching environmental content effectively in digitally mediated contexts (Wineburg & McGrew, 2019).

Teachers' assessments of AI-generated material using the CRAAP framework revealed generally favorable yet discerning judgments. Relevance and Accuracy were evaluated with relative confidence, whereas Authority and Purpose elicited greater ambiguity. These trends are consistent with literature showing that teachers identify surface-level indicators of quality more readily than deeper markers of source integrity and intent (Nguyen et al., 2023). Despite moderately high ratings across the CRAAP dimensions, self-reported confidence in evaluating AI-generated content remained limited, a domain that is increasingly central to informed environmental reasoning and decision-making (Lombardi et al., 2021). Notably, a statistically significant but weak positive correlation was observed between favorable attitudes toward AI and self-assessed evaluative skills. This suggests that openness to AI can support adoption but is insufficient to ensure robust data evaluation competencies (Ottenbreit-Leftwich et al., 2018).

Following the training intervention, several positive shifts appeared. Perceptions of AI-generated data improved significantly, with 56% of participants agreeing or strongly agreeing that such content was reliable, along with a notable decrease in neutral responses. This change likely reflects increased familiarity with both AI outputs and the evaluative frameworks introduced during training. Most participants also reported actively verifying source validity and current relevance, indicating heightened epistemic vigilance. Qualitative feedback supported these findings: teachers noticed that students became more curious about data origins and started asking critical questions about reliability. One participant said, "After our lesson using AI tools, my students started questioning why some AI responses lacked sources or referenced outdated data. That was new." These reflections suggest that the classroom application phase not only strengthened teachers' skills but also had a positive ripple effect on students' critical thinking.

While concerns about AI's potential to spread misconceptions remained, participants showed a more active awareness of these risks after training, indicating increased metacognitive understanding. Similarly, although it remained difficult to distinguish AI content from verified scientific data, greater agreement on this point may reflect awareness of the complex evaluation process. Post-intervention CRAAP-based evaluations showed moderate to positive judgments, with notable improvements in Currency, Relevance, and especially Authority. Authority ratings increased by over 20 percentage points, indicating a stronger perceived ability to assess source credibility. However, the reduced difference between valid and invalid items in areas like Accuracy and Purpose calls for caution.

This trend may signal a generalized trust effect, in which heightened confidence inadvertently leads to overextension of evaluative judgments. Teacher reflections echoed this risk, with some reporting difficulty in helping students understand more complex evaluative concepts, such as authorship credibility and purpose bias.

These observations underscore the importance of designing future professional development initiatives that explicitly address the potential for overconfidence arising from increased trust in AI outputs. Integrating strategies that promote reflective practice, metacognitive monitoring, and deeper critical thinking can help counterbalance the generalized trust effect, thereby strengthening teachers' capacity to make nuanced and evidence-based evaluative judgments. These findings highlight the continued need for scaffolding advanced evaluative skills, rather than relying solely on short-term interventions. From a theoretical perspective, this study contributes to the growing discourse on teacher AI literacy by demonstrating the value of combining digital literacy with established evaluative frameworks such as CRAAP. It positions teachers not merely as passive users of AI, but as critical mediators who guide students in interrogating the reliability and intent of AI-generated content. By cultivating evaluative skills, training programs can strengthen teacher agency and promote informed, reflective classroom practices.

At the same time, several limitations must be acknowledged. First, the reliance on self-reported measures may have led to an overestimation of actual evaluative competencies. Second, the study was situated within a single national context, which constrains the extent to which the findings can be generalized across different cultural or curricular environments. Third, although immediate post-training gains were documented, the study did not capture whether these improvements were sustained over the longer term. Fourth, the composition of the sample, characterized by a notably high proportion of female teachers (93.2%), may also have shaped the findings in ways that are not fully generalizable. While this imbalance reflects broader demographic patterns in the teaching profession, it raises important questions about how gendered perspectives might influence teachers' attitudes toward AI, their evaluative practices, and their mediation of AI-related content in the classroom. Future research would benefit from exploring more balanced or diverse samples to investigate whether and how gender interacts with teachers' engagement in AI literacy and environmental education. Addressing these limitations will contribute to building a more comprehensive understanding of how AI literacy can be effectively embedded in teacher education.

The practical implications of these findings are twofold. For teacher education, they underscore the need to integrate AI literacy into both pre-service and in-service training, not merely as technical upskilling, but as a framework for fostering critical evaluation, ethical reasoning, and evidence-based pedagogy. For policy, they highlight the importance of embedding data literacy competencies, including source traceability, authorship verification, and cross-referencing, within broader digital education agendas. Sustained mentorship and peer-exchange platforms may further support teachers in consolidating these competencies over time.

Overall, this study demonstrates that targeted training can enhance teachers' evaluative skills and attitudes toward AI, but also that such efforts must be continuous, critically oriented, and explicitly designed to strengthen teacher agency. By equipping educators to act as informed mediators between AI systems and students, professional development initiatives can promote responsible AI use and help prepare learners to navigate an increasingly complex, data-driven educational landscape.

Limitations

Although the sample comprised participants from various regions of Greece, its relatively small size constrains the generalizability of the findings. Moreover, the limited number of secondary education teachers restricts the extent to which the results can be extrapolated to the wider population of in-service secondary teachers in Greece. Furthermore, even though gender was not a variable of primary focus, the imbalance in gender representation within the sample constitutes an additional limitation that should be acknowledged. The exclusive reliance on self-reported data may also have introduced biases related to social desirability or recall inaccuracies. While age and gender information was collected, other potentially influential demographic characteristics were not considered.

Statement of Researchers

Researchers' contribution rate statement: Maria Christoforaki conducted the research, including study conceptualization, methodology design, data collection and analysis, and manuscript writing.

Evangelia Mavrikaki and Apostolia Galani supervised the work, provided guidance on methodology, research implementation, data analysis and critically reviewed and refined the manuscript.

Conflict statement: The author declares no conflict of interest.

Data availability statement: This study did not generate new datasets. The data supporting the conclusions of this research are not publicly available due to ethical considerations and to protect participant privacy. Access to the data is restricted to ensure confidentiality. Requests for further information regarding the data can be directed to the corresponding authors.

Ethical considerations: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants for being included in the study."

Author Biographies

Maria Christoforaki is a PhD candidate at the National and Kapodistrian University of Athens, specializing in geography education, digital technologies, and environmental research. She holds an MSc in Teaching and Public Understanding of Science and Digital Technologies and has participated in multiple EU-funded projects, including Erasmus+ KA220-SCH initiatives such as "SchoolFAN" and "HEAT." Her research focuses on geography literacy, the development of digital learning resources, and blended learning environments to enhance socio-scientific reasoning skills, formal and in-formal education, virtual museums, and climate change awareness in primary and secondary education. Actively engaged in science outreach, she has organized educational activities for major events, including the Athens Science Festival and European Researchers' Night, and has received awards in educational robotics and science competitions

Dr. Evangelia Mavrikaki is a biologist and a professor in the Department of Pedagogy and Primary Education and an expert in biology education and teachers' training and proved by her participation as an expert trainer in international and/or nationwide teachers' training projects (e.g. 1. "Introduction and management of Innovations in the Educational Community", MIS375642 by the Greek Center for the Development of Educational Policy GSEE and the Institution of Educational Policy of the Greek Ministry of Education, 2. "The Education Modernization Project" by the Ministry of Science and Education of Kazakhstan under the technical and economic support of the World Bank (Loan Agreement 8709-KZ). She is also the author or editor of 22 books (one of which about environmental education and one about health education) and 132 Greek and international papers or chapters and the author of the official school textbooks for biology in lower secondary education from 2007 till today. She is a co-founding member of the Hellenic Scientific Society for Environmental Education for Sustainability and a member of the board of the Panhellenic Association of Bioscientists (former vice president). She is also guiding PhD students' research in environmental education/environmental literacy/education for the achievement of the SDGs.

Dr. Apostolia Galani is a geographer and a professor in the Department of Pedagogy and Primary Education. From her position, she delivers lectures to pre-service Students and in-service teachers at pre and post graduate level, she organizes teachers training workshops and she is key-member of the team for the accreditation of the curriculum of the Department. She has participated as a designer and trainer in european funded or national funded pre-service and in-service teachers' training projects ie. (i) The "Education Modernization Project" by the Ministry of Science and Education of Kazakhstan under the technical and economical support of the World Bank (Loan Agreement 8709-KZ) (ii) The "STEM CAPACITY BUILDING lifelong learning project" (2018-2021) (iii) The "UNI-T Teachers' Academy" project (2022-2025). She is the author of the official school textbooks for Geography in lower secondary education from 2007 till today.

REFERENCES

Bender, E. M., Gebru, T., McMillan-Major, A., & Shmitchell, S. (2021). On the dangers of stochastic parrots: Can language models be too big? Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency, 610–623. https://doi.org/10.1145/3442188.3445922

Bozkurt, A., & Sharma, R. C. (2023). Challenging the status quo and exploring the new boundaries in the age of algorithms: Reimagining the role of generative AI in distance education and online learning. Asian Journal of Distance Education, 18(1). https://asianjde.com/ojs/index.php/AsianJDE/article/view/714

Brown, M., Bisbee, J., Lai, A., Bonneau, R., Nagler, J., & Tucker, J. A. (2022). Echo chambers, rabbit holes, and algorithmic bias: How YouTube recommends content to real users. SSRN. https://doi.org/10.2139/ssrn.4114905

Cheng, J., Xu, Z., Bambrick, H., Su, H., Tong, S., & Hu, W. (2018). Heatwave and elderly mortality: An evaluation of death burden and health costs considering short-term mortality displacement. Environment International, 115, 334–342. https://doi.org/10.1016/j.envint.2018.03.041

Jemetz, M., Dolezal, D., & Motschnig, R. (2025). Secondary teachers' self-perceived AI competences in relation to renowned European digital competence frameworks. In Z. Pluhár & B. Gaál (Eds.), Informatics in schools. Innovative approaches to computer science teaching and learning. ISSEP 2024 (Lecture Notes in Computer Science, Vol. 15228, pp. 3–15). Springer. https://doi.org/10.1007/978-3-031-73474-8_1

Kong, S. C., Yang, Y., & Hou, C. (2024). Examining teachers' behavioural intention of using generative artificial intelligence tools for teaching and learning based on the extended technology acceptance model. Computers and Education: Artificial Intelligence, 7, 100328. https://doi.org/10.1016/j.caeai.2024.100328

Lombardi, D., & Bailey, J. M. (2023). Science learning and teaching. In Handbook of educational psychology (pp. 531–552). Routledge.

Meriam Library, California State University, Chico. (n.d.). Evaluating information – Applying the CRAAP Test. https://guides.lib.chico.edu/c.php?g=414315&p=2828764

Naqvi, W. M., Ganjoo, R., Rowe, M., & Pashine, A. A. (2025). Critical thinking in the age of generative AI: Implications for health sciences education. Frontiers in Artificial Intelligence. (in press)

Nguyen, A., Ngo, H. N., Hong, Y., et al. (2023). Ethical principles for artificial intelligence in education. Education and Information Technologies, 28, 4221–4241. https://doi.org/10.1007/s10639-022-11316-w

Nunnally, J. C. (1978). An overview of psychological measurement. In Clinical diagnosis of mental disorders: A handbook (pp. 97–146). Springer. https://doi.org/10.1007/978-1-4684-2490-4_4

Oates, A., & Johnson, D. (2025). ChatGPT in the classroom: Evaluating its role in fostering critical evaluation skills. International Journal of Artificial Intelligence in Education. https://doi.org/10.1007/s40593-024-00452-8

Ottenbreit-Leftwich, A., Liao, J. Y. C., Sadik, O., & Ertmer, P. A. (2018). Evolution of teachers' technology integration knowledge, beliefs, and practices: How can we support beginning teachers' use of technology? Journal of Research on Technology in Education, 50(4), 282–304. https://doi.org/10.1080/15391523.2018.1487350

Selvarajan, G. (2025). Enhancing transparency in data analytics through explainable artificial intelligence. Journal of Computational Analysis and Applications. (in press)

Selwyn, N., Hillman, T., Eynon, R., Ferreira, G., Knox, J., Macgilchrist, F., & Sancho-Gil, J. M. (2019). What's next for ed-tech? Critical hopes and concerns for the 2020s. Learning, Media and Technology, 45(1), 1–6. https://doi.org/10.1080/17439884.2020.1694945

Strubell, E., Ganesh, A., & McCallum, A. (2020). Energy and policy considerations for modern deep learning research. Proceedings of the AAAI Conference on Artificial Intelligence, 34(9), 13693–13696. https://doi.org/10.1609/aaai.v34i09.7123

Wibawa, A. P., Handayani, A. N., Anugrah, P., & Utama, A. B. P. (2024). A novel "conceive, design, implement, operate (CDIO)" framework for evaluating artificial intelligence–generated scholarly manuscripts. Science Editing, 12(1), 70–75. https://doi.org/10.6087/kcse.348

Wineburg, S., & McGrew, S. (2019). Learning more when evaluating digital information. Teachers College Record, 121(11), 1–40. https://doi.org/10.1177/016146811912101102

Wu, C.-J., Raghavendra, R., Gupta, U., Acun, B., Ardalani, N., Maeng, K., Chang, G., Aga, F., Huang, J., Bai, C., Gschwind, M., Gupta, A., Ott, M., Melnikov, A., Candido, S., Brooks, D., Chauhan, G., Lee, B., Lee, H.-H., Akyildiz, B., Balandat, M., Spisak, J., Jain, R., Rabbat, M., & Hazelwood, K. (2022). Sustainable AI: Environmental implications, challenges and opportunities. Proceedings of Machine Learning and Systems, 4, 795–813. https://doi.org/10.48550/arXiv.2111.00364

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – Where are the educators? International Journal of Educational Technology in Higher Education, 16, 39. https://doi.org/10.1186/s41239-019-0171-0