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Ethical AI Literacy among Teachers in Italian-speaking Switzerland: Predictors and Profiles

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Abstract: Artificial Intelligence (AI) is profoundly transforming education, with applications ranging from intelligent tutoring systems to adaptive platforms and generative tools based on machine learning and deep learning. In schools, these technologies offer opportunities for personalized learning, automated assessment, and inclusive practices, while also raising ethical concerns related to *bias*, *transparency*, and *data protection*. This study, part of the national project *Bridging the Gap: Empowering Teachers about AI Education*, aims at investigating teachers' ethical AI literacy in Canton Ticino through a quantitative descriptive-correlational approach. The analysis is based on questionnaire data collected from a sample of 701 secondary-school teachers. Results indicate a mean value of M = 4.98 for ethical AI literacy, measured on a 7-point Likert scale, with significant differences observed by age, experience, and gender. *Ordinal logistic regression* indicates that ethical awareness is not significantly associated with general exposure to technology, but rather with the specific teaching practices in which AI is integrated. *Cluster analysis* identified four teacher profiles, with the highest scores in ethical AI literacy being reported by the group displaying greater inclination towards critical and ethical reflections on technology. The study suggests the potential benefit of training programs that integrate technical, ethical, and instructional-design skills, in line with international recommendations.

Keywords: Artificial Intelligence; Ethical *AI literacy*; Teachers; Teacher Training

1. Introduction

1.1 Background and relevance of AI ethical literacy in education

Artificial intelligence (AI) is profoundly transforming educational systems, with applications ranging from intelligent tutoring systems and *chatbots* to adaptive platforms and generative tools based on *machine learning* and *deep learning* (Ait Baha, El Hajji, Es-Saady, & Fadili, 2024; Bekiaridis & Attwell, 2024; Celik, 2023). In schools, these technologies are used, e.g., in order to personalize learning paths, automate

assessments, and support inclusive practices (Choi, Yang, & Goo, 2024; Floridi, 2019). However, these opportunities are accompanied by significant risks, such as algorithmic *bias,* lack of transparency in decision-making, and issues of *data protection* (Gouseti, James, Fallin, & Burden, 2025; Holmes, Bialik, & Fadel, 2019; Mittelstadt, Allo, Taddeo, Wachter, & Floridi, 2016).

AI literacy refers to the cognitive, technical, and ethical skills required to understand and critically evaluate intelligent systems (Long & Magerko, 2020; Ng, Leung, Chu, & Qiao, 2021; Wang, Rau, & Yuan, 2022). The ethical dimension of *AI literacy* (*ethical AI literacy*) refers to the capacity of individuals to engage with AI in an informed and responsible manner, particularly concerning ethical principles such as fairness, accountability, and transparency. Moreover, ethical *AI literacy* encompasses the ability to critically evaluate AI solutions, assessing their risks and potential biases, and understanding the ethical contexts in which they operate (Mittelstadt et al., 2016).

Several factors contribute to the development of ethical *AI literacy*. One significant factor is the accessibility and availability of quality educational resources. Studies have highlighted the need for tailored educational *frameworks* that accommodate different demographics, varying from K–12 students to educators and professionals (OECD, 2023). Such *frameworks* should incorporate various pedagogical strategies, including hands-on experiences with AI tools and ethical scenarios, to facilitate deeper engagement and understanding (Pagliara et al., 2024).

Some guidelines providing a human-centred *framework* for regulating and using generative AI in education and research, addressing ethical and policy issues while highlighting practical applications and long-term implications, have been published by UNESCO (UNESCO, 2021, 2023). At the same time, established teacher training models, such as TPACK (Koehler, Mishra, & Cain, 2013) and DigCompEdu (Redecker & Punie, 2017), have been expanded to include AI competences that teachers should acquire (Bekiaridis & Attwell, 2024; Pellegrini & Sebastiani, 2024). At the policy level, the *Digital Switzerland Strategy* (Swiss Federal Council, 2023) emphasizes the need to strengthen digital education and promote the ethical use of intelligent technologies but does not yet contain specific operational guidelines for the school environment. In light of this scenario, ethical *AI literacy* emerges as a key skill for ensuring the pedagogically sound and socially equitable integration of intelligent technologies in educational contexts.

1.2 Research Questions

The aim of this study is to answer the following research questions:

1. What is the level of ethical AI literacy among teachers in Canton Ticino?
2. What factors are related to the current level of ethical AI literacy and may contribute to its development?

2. Materials and Methods

2.1. Research Design

The study is part of the national project *Bridging the Gap: Empowering Teachers about AI Education*, funded by the Swiss National Science Foundation (SNSF) and carried out by the Dalle Molle Institute for Artificial Intelligence Studies (IDSIA,

USI–SUPSI) and the Department of Education and Learning (DFA/ASP, SUPSI). A quantitative, *descriptive–correlational design* was adopted. Data collection was conducted via an *online questionnaire* administered through the *Qualtrics* platform. Participation was voluntary and anonymous, in accordance with the *new Federal Act on Data Protection* (nLPD).

2.2. Participants

Recruitment was conducted through self-selection within a census approach, involving lower secondary school teachers (students aged 11–14) and upper secondary school teachers (students aged 15–18) in Canton Ticino (Italian-speaking Switzerland). Teachers were invited via institutional mailing lists, professional networks, and official school channels.

A total of 701 teachers responded. As shown in Table 1, women constituted approximately two-thirds of the sample (59.6%). The distribution by age group was balanced, with both younger and more senior teachers represented. Most respondents teach in lower secondary school (67.6%). Regarding professional experience, 66.3% of participants had more than ten years of service.

Table 1. *Descriptive statistics of the main variables*

Variable	Group	Size	%
Gender	Female	418	59.6
	Male	274	39.1
	Not reported	9	1.3
Age group	Under 40	225	32.2
	Over 40	476	67.8
School level	Lower secondary	474	67.6
	Upper secondary	199	28.4
	Not reported[1]	28	4.0

[1] "Not reported" includes teachers working across both school levels and some with support or administrative functions.

Seniority	< 5 years	100	14.3
	5–10 years	136	19.4
	> 10 years	465	66.3

2.3. Instruments

The questionnaire was developed by combining items and scales from validated instruments and integrating additional items[2]. Specifically, it included eight sections, each aimed at capturing a distinct aspect of the participant's profile or attitude: socio-demographic information; experience with AI; trust in *AI*; frequency and context of use of *AI* tools for both professional tasks and leisure; criteria applied when selecting *AI* tools; attitude toward AI use in education; prior training on AI; *AI literacy*.

For the purposes of this study, particular attention was given to the socio-demographic and professional section (gender, age, school level, seniority); the section on attitudes towards *AI* in education, measured through 12 items inspired by the *Opinion Scale on Artificial Intelligence in Education* (Uygun, 2024)—for example: "*AI saves time in preparing lessons*" or "*AI makes learning more superficial*"; the *AI literacy* section, based on the *framework* proposed by Wang et al. (2022); and the section on *AI* use in teaching, which examined both frequency and application contexts (e.g., *How often do you use AI tools for preparing lessons, in class, for administrative tasks, or in your free time?*).

The *AI Literacy Scale* by Wang, Rau, and Yuan (2022) was translated into Italian and is based on a 7-point *Likert scale*. The original version includes four constructs: *awareness*, *usage*, *evaluation*, and *ethics*. For the purposes of this study, the items were reorganized into two composite dimensions:

- Operational *AI literacy* (9 items): including awareness, use, and evaluation of *AI* tools (e.g., "*I can skillfully use AI applications or products to help me with my daily work*").

- Ethical *AI literacy* (3 items): focusing on the normative and social implications of *AI* (e.g., "*I always comply with ethical principles when using AI applications or products*").

2.4 Data Analysis

Analyses were conducted using the *Jamovi* software (The *Jamovi* Project, 2024). A characterization of the sample and the variables was obtained by means of different descriptive statistics (frequencies, means, standard deviation). The internal consistency of the scales was assessed using Cronbach's α. Robust analyses of variance (*Welch ANOVA*) were used to examine differences between sociodemographic groups, given the slight deviation from normality of the distributions.

[2] The questionnaire is accessible here: https://aris.supsi.ch/entities/publication/e126f4c5-9450-4aa7-b40a-d3b826e35ca7

Significant predictors of ethical AI literacy were identified using regression models such as ordinal logistic regression. Finally, a *k-means cluster analysis* was conducted to identify teacher profiles based on their attitudes towards *AI* in education.

3. Results

3.1. Internal Reliability

The internal consistency of the *AI literacy* scales was assessed using Cronbach's α. The Operational *AI literacy* subscale (9 items) showed high reliability (α = .89), while the Ethical *AI literacy* subscale (3 items) yielded a lower value (α = .57). The modest coefficient for the ethical dimension is consistent with the reduced number of items, as reliability indices are sensitive to scale length. Despite this limitation, the subscale was retained due to its theoretical relevance and the central role of ethical considerations in this study.

3.2 Descriptive Analysis

Descriptive analysis showed that the main variable under examination, *Ethical AI literacy*, had a mean score of 4.98 (SD = 1.18) on a 7-point scale. The median was 5.00, while the mode was 4.00, reported by 19% of the sample. The range of observed scores was 5.33, indicating a relatively wide distribution of responses.
The Shapiro–Wilk normality test ($W = 0.964$, $p < .001$) indicated a slight deviation from normality, which necessitated the use of robust statistical tests in subsequent inferential analyses.

3.3 Group Comparison

Welch's ANOVA tests revealed significant differences in *Ethical AI literacy* scores across multiple factors. Specifically:

- Age: Teachers over 40 (M = 5.05) achieved significantly higher scores than those under 40 (M = 4.82), $F(1, 504) = 4.18$, $p = .041$.
- Work experience: Teachers with more than ten years of experience reported higher scores (M = 5.10) than those between 5 and 10 years (M = 4.78) and those with less than 5 years (M = 4.78), $F(2, 503) = 5.81$, $p = .003$. A post hoc Tukey HSD test indicated that the mean of teachers with more than ten years of experience was significantly higher than that of the 5–10 years group ($p = .007$).
- Gender: Women reported higher mean scores (M = 5.07) compared to men (M = 4.85), $F(1, 501) = 4.34$, $p = .038$.

3.4 Ordinal Logistic Regression

Two regression models were tested, both predicting Ethical AI literacy based on Operational AI literacy, contexts of AI tool usage, age, and gender. A preliminary linear regression model, used for exploratory purposes, explained about 14% of the variance in Ethical AI literacy ($R^2 = .142$). To account for the ordinal categorical nature of the dependent variable, an ordinal logistic regression was also conducted. The model was significant ($\chi^2(8) = 65$, $p < .001$) and explained a modest but mean-

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ingful proportion of variance (McFadden R^2 = .026; Nagelkerke R^2 = .125). The analysis identified the following significant predictors of higher ethical literacy:

- Operational AI literacy – the strongest positive predictor (β = 0.595, p < .001), confirming that technical–operational mastery of AI tools supports greater ethical awareness.

- Use of AI for preparing lessons (β = 0.170, p = .009) – teachers who integrate AI into lesson planning show higher ethical sensitivity.

- Use of AI for professional tasks outside the classroom (β = 0.128, p = .048) – professional, non-teaching uses are also positively associated with ethical literacy.

- Age (β = 0.420, p = .013) – older teachers report higher ethical literacy, suggesting an effect of professional maturity.

- Gender (β = −0.538, p < .001) – women display significantly lower ethical literacy than men; the negative coefficient reflects the coding, where male teachers were the reference group.

In summary, the results show that ethical literacy is not primarily driven by general exposure to AI, but rather by operational competence, use in teaching-related and professional contexts, and sociodemographic factors such as age and gender.

3.5 Cluster Analysis

A k-means cluster analysis was conducted to group teachers based on their attitudes toward AI in education (12 items inspired by Uygun, 2024). The analysis was run with a predefined number of clusters (k=4). The iteration history indicated convergence after 12 iterations.

Figure 1. Distribution by cluster of the responses to the 12 items of the "Attitude toward AI in Education" scale. Error bars represent the standard error of the mean.

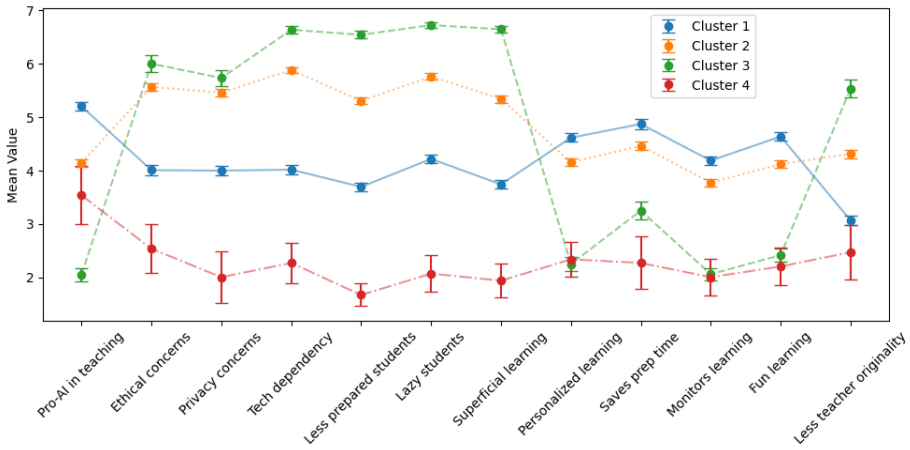

Figure 1 shows the mean scores of the "Attitude toward AI in Education" items (Likert scale 1–7) for each cluster. Based on these results, the four groups can be characterized as follows:

- Cluster 1: Pragmatic–Instrumental (N = 214) – Teachers who see AI mainly as a tool for simplifying tasks and increasing efficiency, with limited attention to ethical aspects.

- Cluster 2: Balanced–Constructive (N = 301) – Teachers with a balanced view, recognizing the potential of AI while also considering ethical implications.

- Cluster 3: Reflective–Ethical (N = 126) – Teachers who adopt a more critical and reflective stance, emphasizing ethical concerns in the educational use of AI.

- Cluster 4: Minimizing–Skeptical (N = 15) – Teachers with a skeptical view of the potential of AI, coupled with low ethical concern.

ANOVA results indicated significant differences between the clusters for all variables ($p < .001$). A further ANOVA revealed significant differences in Ethical AI literacy scores, $F(3, 502) = 7.09$, $p < .001$. In particular, the Reflective–Ethical cluster ($M = 5.4$) scored significantly higher than the Pragmatic–Instrumental ($M = 4.7$, $p < .001$) and the Balanced–Constructive ($M = 5.0$, $p = .036$) clusters.

4. Discussion

The results paint a complex picture of *ethical AI literacy* among teachers in Canton Ticino. Descriptive analysis shows an average level of 4.98, with a heterogeneous distribution reflecting substantial differences between subgroups. Inferential analyses indicate that age and professional experience are facilitating factors, likely because they are associated with greater exposure to complex educational situations and the ability to critically question technologies. Gender is a significant variable, with female teachers reporting higher mean scores, suggesting a greater ethical and relational sensitivity.

Ordinal logistic regression pointed to the fact that ethical awareness may not depend on general exposure to technology, but rather on the integration of *AI* in teaching and professional activities. *Operational AI literacy* and use for professional tasks outside the classroom are positively associated with ethical competence, while no significant association emerged with the use of *AI* in free time.

Finally, the *cluster analysis* highlighted four teacher profiles, ranging from the *Reflective–Ethical* to the *Pragmatic–Instrumental* and from the *Minimizing–Skeptical* to the *Balanced–Constructive*, showing how the teaching community is characterized by differentiated attitudes. These findings have important implications for the design of targeted training programs: *Pragmatic–Instrumental* teachers could benefit from courses focusing on ethical dimensions, while *Minimizing–Skeptic* teachers may require motivational support and gradual guidance toward reflective use.

5. Conclusions

Focusing on the Swiss Canton of Ticino, this study provides an empirical contribution to the understanding of *ethical AI literacy* among teachers, a subject still underexplored in the literature. The results showed that ethical literacy is not a mere by-product of *AI* use: while greater *Operational AI literacy* and professional use of *AI* were positively associated with ethical awareness, the *cluster analysis* revealed that reflective and balanced attitudes toward *AI* are particularly linked to higher levels of ethical literacy.

Although this study does not allow for the evaluation of specific interventions, the findings highlight the potential value of structured and systematic training opportunities that combine operational and ethical aspects. In line with international recommendations (UNESCO, 2021, 2023; Zawacki-Richter, Marín, Bond, & Gouverneur, 2019), continuing education programs could contribute to strengthening not only teachers' technical familiarity but also their reflective capacity and pedagogical responsibility.

In conclusion, integrating *AI* into education emerges not only as a technological issue but also as a pedagogical and ethical challenge. Promoting an *ethical AI literacy* that balances operational competence with critical reflection may help foster teaching practices that are technologically effective, pedagogically meaningful, and ethically responsible.

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