

Correction

Correction: Salas-Pilco et al. Artificial Intelligence and Learning Analytics in Teacher Education: A Systematic Review. *Educ. Sci.* 2022, 12, 569

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There was an error in the original publication [1]. The authors have requested changes be made to the published paper as they describe Taiwan as a country in the article and hope to change the description to “Country/Region” and “China Taiwan”.

A correction has been made to the **first paragraph of Section 3. Results and Table 2:**

This review includes 30 studies based in 16 countries/regions, with the following distribution: Canada (3), China (8), Estonia (1), Germany (3), India (1), Indonesia (1), Japan (1), Korea (1), Malaysia (1), Morocco (1), Portugal (1), Rwanda (1), Spain (1) China Taiwan (1), Turkey (2), USA (3). The analysis guided by the research questions provides some insights into the impact of AI and LA on teacher education.



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Table 2. Summary of the studies included in this review.

Author(s) and Year	Country/Region	Goals and Objectives	Participants	Data Sources	Techniques	Tools	Ethical Procedures	Results
Bao et al. (2021) [31]	China	To visualize students' behaviors and interactions.	35 PSTs	<ul style="list-style-type: none"> Knowledge elaboration (K): discussion of topics and posts Behavior patterns (B): posting frequency; posts' content Social interaction (S): network density, network cohesion, and network interactions 	LA dashboard	<ul style="list-style-type: none"> Moodle platform LA dashboard Knowledge–Behavior–Social Dashboard tool (KBSD) 	n.d.	The KBSD tool has the potential to assist teachers in detecting learning problems. The most common strategy was cross-group; the interventions involved cognitive guidance, scaffold instruction, and positive evaluation.
Benaoui and Kassimi (2021) [32]	Morocco	Perceptions of PSTs' digital competence.	291 PSTs	<ul style="list-style-type: none"> DigComp framework (five dimensions): information and data literacy, communication and collaboration, digital content creation, safety, and problem solving 	AI machine learning	<ul style="list-style-type: none"> AI tools: K-means clustering 	n.d.	PSTs felt competent when using digital technologies daily, but they did not feel competent in digital content creation and problem solving. This might be due to the predominance of theoretical knowledge at the expense of real practice in teaching training.
Chen (2020) [33]	China	To investigate whether visual learning analytics (VLA) has a significant influence on teachers' beliefs and self-efficacy when guiding classroom discussions.	46 ISTs	<ul style="list-style-type: none"> Video discourse data: number of words; number of turns; teacher–student turn-taking patterns Visualizing talk strategies: elaborating, reasoning, listening, and thinking with others 	LA visual learning analytics (VLA)	<ul style="list-style-type: none"> Classroom discourse analyzer (CDA) is a VLA tool that automatically extracts and visualizes low-inference discourse information 	n.d.	The VLA approach to video-based teacher professional development had significant effects on teachers' beliefs and self-efficacy, and influenced their actual classroom teaching behavior.
Cutumisu and Guo (2019) [34]	Canada	To determine PSTs' knowledge of and attitudes toward computational thinking through the automatic scoring of short essays.	139 PSTs	<ul style="list-style-type: none"> Short essays (500-word reflection) about the experience of solving a block-based visual programming scenario were analyzed 	AI machine learning	<ul style="list-style-type: none"> Moodle platform Latent Dirichlet Allocation library in Python. Code.org 	PSTs provided informed consent	Topics that emerged from PSTs' reflection included assignment (66.7%), skill (11.6%), activity 10.1%, and course (6.5%).

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Author(s) and Year	Country/Region	Goals and Objectives	Participants	Data Sources	Techniques	Tools	Ethical Procedures	Results
Fan et al. (2021) [35]	China	To reveal links between learning design and self-regulated learning.	7030 PSTs, 1758 ISTs	<ul style="list-style-type: none"> Number of sessions, duration, number of actions, etc. Content access, content revision, discussion, assessment, help-seeking, and search 	LA	<ul style="list-style-type: none"> MOOC R package AI tools: Expectation-maximization (EM) algorithm; Bayesian information criterion (BIC); TraMineR 	n.d.	Four meaningful learning tactics were detected with the EM algorithm: search (lectures), content and assessment (case-based or problem-based), content (project-based), and assessment.
Hayward et al. (2020) [36]	Canada	To explore PSTs' engagement with models of universal design for learning and blended learning concepts.	197 PSTs	<ul style="list-style-type: none"> Access features: location, date, time, and regularity (average number of logins/week) Content features: screencasts; quizzes 	LA	<ul style="list-style-type: none"> Moodle platform 	n.d.	The feature regularity of access had a moderate relationship with student engagement. High achievers tended to have a set of strategies.
Hsiao et al. (2019) [37]	China Taiwan	To assess the qualities of pre-service principals' video-based oral presentations through automatic scoring.	200 pre-service principals	<ul style="list-style-type: none"> Video-based speech features: content, speech organization, appropriate word usage, proper etiquette, correct enunciation, fluent prosody, timing control 	AI machine learning	<ul style="list-style-type: none"> Supervised algorithms: support-vector machine (SVM) classifier, logistic regression, random forests, and gradient-boosted decision trees 	n.d.	The SVM classifier had the best accuracy (55%). It was found that human experts can potentially suffer undesirable variabilities over time, while automatic scoring remains robust and reliable over time.
Ishizuka and Pellerin (2020) [38]	Japan	To assess real-time activities in second language classrooms.	4 PSTs	<ul style="list-style-type: none"> Class, group, and individual work Student modalities: reading, writing, listening, and speaking Material: extended, minimal, native, or non-native 	AI	<ul style="list-style-type: none"> Video on the ePortfolio in Moodle AI mobile communicative orientation of language teaching (COLT) scheme 	n.d.	The integration of AI mobile COLT analysis has strong potential to follow-up PSTs' progress throughout their practicum.

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Author(s) and Year	Country/Region	Goals and Objectives	Participants	Data Sources	Techniques	Tools	Ethical Procedures	Results
Jensen et al. (2020) [39]	USA	To provide automated feedback on teacher discourse to enhance teacher learning.	16 ISTs	<ul style="list-style-type: none"> Discourse data: recordings of classroom conversations. Included variables: specificity, instructional talk, authentic questions, dialogic, cognitive level 	AI machine learning	<ul style="list-style-type: none"> Random forests (RF) classifier and regression IBM Watson AI speech recognizer 	n.d.	The RF classifier had 89% accuracy, generating automatic measurement and feedback of teacher discourse using self-recorded audio data from classrooms.
Karunaratne and Byungura (2017) [40]	Rwanda	To track in-service teachers' behavior in an online course of professional development.	61 ISTs	<ul style="list-style-type: none"> User action data: time, full names, event context, components, event names, activity, IP address and origin Performance data: grades 	LA visual learning analytics	<ul style="list-style-type: none"> Moodle platform R software 	n.d.	Half of the registered teachers never accessed the course. Most of the teachers were actively engaging in the virtual learning environment's activities.
Kasepalu et al. (2021) [41]	Estonia	Teachers' perceptions of collaborative analytics using a dashboard based on audio and digital trace data.	21 ISTs	<ul style="list-style-type: none"> Trustworthiness (0–100), novelty, and usefulness Actionability and receiving new information Level of experience 	LA dashboard	<ul style="list-style-type: none"> CoTrack: a Raspberry-Pi-based prototype with microphones CoTrack's dashboard showing speaking time and social networks Etherpad 	Consent forms were filled out by ISTs and their students	New information enhances teachers' awareness, but it seems that the dashboard decreases teachers' actionability. Therefore, a guiding dashboard could possibly help less experienced teachers with data-informed assessment.
Kelleci and Aksoy (2020) [42]	Turkey	To examine PSTs' and ISTs' experiences using an AI-based-simulated virtual classroom.	16 PSTs, 2 ISTs	<ul style="list-style-type: none"> Discourse data and reflection elements: PSTs' attitudes, experiences, device preferences, comments about the interface, and content and technical issues 	AI simulation	<ul style="list-style-type: none"> SimInClass: an AI-based-simulated virtual classroom Google Classroom learning platform 	Ethical approval from the institution	The SimInClasssimulation was effective in providing clear directions and giving feedback. PSTs suggested that the simulation should give clues as to correct solutions.

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Author(s) and Year	Country/Region	Goals and Objectives	Participants	Data Sources	Techniques	Tools	Ethical Procedures	Results
Kilian et al. (2020) [43]	Germany	To predict PSTs' dropout for a mathematics course and identify risk groups.	163 PSTs	<ul style="list-style-type: none"> Performance: GPA, math grade, TIMSS, age, gender, federal state, school type, type of student 	AI machine learning	<ul style="list-style-type: none"> AI tools: SVM, LR, LR with elastic net regularization, and tree-based methods 	PSTs provided written informed consent	Risk level 1: score ≤ 12 (highest risk), GPA > 2.1 ; risk level 2: score ≤ 12 (high risk), GPA ≤ 2.1 ; risk level 3: score > 12 (moderate), $1.6 < \text{GPA} \leq 2$.
Kosko et al. (2021) [44]	USA	To examine PSTs' professional noticing of students through video and ML.	6 PSTs, subsample of 70 PSTs	<ul style="list-style-type: none"> Behavior patterns: recordings of PSTs' viewing a 360 degrees video with students' actions Short writings: PSTs select one pivotal moment and explain why it is significant 	AI machine learning	<ul style="list-style-type: none"> AI tools: machine learning algorithm 	n.d.	PSTs' actions relevant to pedagogical content-specific noticing could be detected by AI algorithms. PSTs' behavior may have been due to professional knowledge rather than experience.
Lucas et al. (2021) [45]	Portugal	To measure teachers' digital competence and its relation to personal and contextual factors.	1071 ISTs	<ul style="list-style-type: none"> Digital competence areas: Personal: age, gender, teaching experience, confidence, and years using digital technology in teaching Contextual: classroom equipment, students' access to technology, network infrastructure, and curriculum Professional engagement: digital resources, assessment, empowering learners, and facilitating learners' digital competence 	AI machine learning	<ul style="list-style-type: none"> SPSS STATA, fast-and-frugal trees (FFTrees) classifier in machine learning 	(Voluntary and anonymous teachers)	For personal factors, FFTrees had an accuracy of 81%, while for contextual factors it was 66%. For digital competence, the important personal factors were the number of digital tools used, ease of use, confidence, and openness to new technology. The contextual factors included students' access to technology, the curriculum, and classroom equipment.

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Author(s) and Year	Country/Region	Goals and Objectives	Participants	Data Sources	Techniques	Tools	Ethical Procedures	Results
Michos and Hernández-Leo (2018) [46]	Spain	To support community awareness to facilitate teachers' learning design process using a dashboard with data visualizations.	23 PSTs, 209 ISTs	<ul style="list-style-type: none"> ILDE dashboard: profile views, comments, created designs, re-used designs, and edits. 	LA dashboard	<ul style="list-style-type: none"> The Integrated Learning Design Environment (ILDE) dashboard IBM SPSS 22 Heidi SQL and Tableau 	n.d.	The ILDE dashboard can provide an understanding of the social presence in the community of teachers. Visualization was the most commonly used feature. There were time constraints.
Montgomery et al. (2019) [47]	Canada	To examine the relationships between self-regulated learning behaviors and academic achievements.	157 PSTs	<ul style="list-style-type: none"> Self-regulated behaviors: Activating: online access location, day of the week, time of day Sustaining: access frequency Structuring: average logins per week, exam review patterns, number of reviewed quizzes/day 	LA	<ul style="list-style-type: none"> Moodle platform 	n.d.	84.5% of PTSs' access to the platform took place off-campus. The strongest predictors for student success were the access day of the week and access frequency.
Newmann et al. (2021) [48]	Germany	To support PSTs' self-study using chatbots as a tool to scale mentoring processes.	19 PSTs	<ul style="list-style-type: none"> Social bot: user intentions, bot messages System Usability Scale: frequency, ease of use, confidence, consistency 	AI NLP	<ul style="list-style-type: none"> Chatbots: Feedbot for self-study, Litbot for mentoring students' reading 	n.d.	Promising results that bear the potential for digital mentoring to support students.
Post (2019) [49]	USA	To challenge PSTs to analyze and interpret data on students' online behavior and learning.	n.d. PSTs	<ul style="list-style-type: none"> Learning action logs about search terms, visited websites, time spent on each website, and the order in which sites were visited 	LA	<ul style="list-style-type: none"> Thinking app (Chrome extension) that tracks online behaviors 	n.d.	PSTs lacked media literacy skills. Online assignments promoted student-centered learning and critical thinking. The prevalence of multitasking was highlighted.

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Author(s) and Year	Country/Region	Goals and Objectives	Participants	Data Sources	Techniques	Tools	Ethical Procedures	Results
Pu et al. (2021) [50]	Malaysia	To design a service-learning-based module training AI subjects (SLBM-TAIS).	60 PSTs	<ul style="list-style-type: none"> Psychological variables: Practical knowledge: educational beliefs, interpersonal relationships, teaching strategies, self-reflection Motivation: intrinsic motivation, extrinsic motivation, amotivation Other: gender, teaching experience, average academic performance 	AI	<ul style="list-style-type: none"> The SLBM-TAIS educational module 	n.d.	The SLBM-TAIS was effective in training PSTs to teach AI subjects to primary school students. The SLBM-TAIS module influences situational knowledge, teaching strategies, and both intrinsic and extrinsic motivation.
Sasmoko et al. (2019) [51]	Indonesia	To determine teacher engagement using artificial neural networks.	10,642 ISTs	<ul style="list-style-type: none"> Based on the Indonesian Teacher Engagement Index (ITEI): positive psychology, positive education, teacher performance, nationalistic character, and leadership engagement 	AI machine learning (ANN)	<ul style="list-style-type: none"> Django: a website framework for Python Chart.js for data visualization. MongoDB as the database 	Not applicable	The ANN classification accuracy was 97.65%, proving the reliability of the instruments and websites; however, this still requires further testing in terms of both ease of use and trials with diverse data.
Sun et al. (2019) [52]	China	To investigate changes in PSTs' concept of engagement, analyzing data recorded during PSTs' discussions via an MOOC platform.	53 PSTs	<ul style="list-style-type: none"> Discussion data Dimensions based on Bloom's taxonomy: remember, understand, apply, analyze, evaluate, create 	LA	<ul style="list-style-type: none"> MOOC platform 	n.d.	The most frequent discussion behaviors were evaluated (31.52%) and analyzed (27.77%). PSTs with an analytical style implemented multiple strategies for learning.

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Author(s) and Year	Country/Region	Goals and Objectives	Participants	Data Sources	Techniques	Tools	Ethical Procedures	Results
Vazhayil et al. (2019) [53]	India	To introduce AI literacy and AI thinking to in-service secondary school teachers.	34 ISTs	<ul style="list-style-type: none"> Types of AI tasks: text recognition, sentiment analysis, image classification, categorical/numerical data 	AI	<ul style="list-style-type: none"> IBM Watson AI model Mitsuku chatbot Google AI experiment named Emoji Scavenger Hunt Scratch 	15 ISTs consented to recorded video testimonials	77% appreciated peer teaching, 41% preferred the game-based approach, and 24% were concerned about internet access. The best strategy was embracing creative freedom and peer teaching to boost learners' confidence.
Wulff et al. (2020) [54]	Germany	To employ AI algorithms for classifying written reflections according to a reflection-supporting model.	17 PSTs	<ul style="list-style-type: none"> Reflection elements: circumstances, description, evaluation, alternatives, consequences 	AI natural language processing	<ul style="list-style-type: none"> Doc2Vec features Four classifiers: decision trees, multinomial logistic regression, multinomial naive Bayes, stochastic gradient descent 	PSTs provided informed consent	The multinomial logistic regression was the most suitable classifier (0.63). Imprecise writing was a barrier to accurate computer-based classification.
Yang et al. (2020) [55]	China	To enhance self-directed reflective assessment (SDRA) using LA.	47 PSTs	<ul style="list-style-type: none"> Epistemic agency, democratic knowledge, improvable ideas, reflective and transformative assessment, and community knowledge 	LA	<ul style="list-style-type: none"> Knowledge Forum (online notes) 	Ethical approval was obtained from the hosting institution	SDRA fostered PSTs' collective empowerment, as reflected by their collective decision making, synthesis of ideas, and "rising above" ideas.
Yilmaz and Yilmaz (2020) [56]	Turkey	To examine PSTs' perceptions of personalized recommendations and feedback based on LA.	40 PSTs	<ul style="list-style-type: none"> LMS log data: date, login frequency, views per week, participation in discussions 	LA	<ul style="list-style-type: none"> Moodle LMS platform 	(Voluntary participation)	LA helped to identify learning deficiencies, provided self-assessment and personalized learning, improved academic performance, and instilled a positive attitude toward the course.

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Author(s) and Year	Country/Region	Goals and Objectives	Participants	Data Sources	Techniques	Tools	Ethical Procedures	Results
Yoo and Rho (2020) [57]	Korea	To determine ISTs' training and professional development using ML.	2933 ISTs, 177 principals	<ul style="list-style-type: none"> Based on the Teaching and Learning International Survey (TALIS) 2013: types of activities, participation rates, intensity of participation, mentoring and induction programs 	AI machine learning	<ul style="list-style-type: none"> Group Mnet technique (glmnet package). R software 	Not applicable	Identified 18 predictors of ISTs' professional development. Found 11 new predictors related to ISTs' pedagogical preparedness, feedback, and participation.
Zhang J. et al. (2021) [58]	China	To build an intelligent assessment system of PSTs teaching competency.	240 PSTs	<ul style="list-style-type: none"> PSTs' teaching competency framework (six dimensions): professional foundation, instructional design, teaching implementation, technology application, teaching evaluation, reflective development 	AI machine learning	<ul style="list-style-type: none"> AI tools: Back Propagation (BP) neural network Delphi and Analytic Hierarchy Process (AHP) methods Matlab software 	n.d.	The trained model can be used to evaluate PSTs' competency on a large scale, its relative error was small between 0–0.2.
Zhang S. et al. (2021) [59]	China	To automatically detect the discourse characteristics of in-service teachers from online textual data.	1834 ISTs	<ul style="list-style-type: none"> Discourse characteristics: number of posts per teacher, length of post per teacher, much or little new information, high or low topic relevance 	AI natural language processing	<ul style="list-style-type: none"> Word2vec toolkit to generate lexical vectors based on AI-NLP 	Ethical approval from the institution	New and relevant information was posted at the beginning of the online discourse. Cluster analysis showed three different posts: relevant topic with new information, another with little new information, and a less relevant topic with little new information.

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Author(s) and Year	Country/Region	Goals and Objectives	Participants	Data Sources	Techniques	Tools	Ethical Procedures	Results
Zhao et al. (2021) [60]	China	To improve the outdoor learning experience and build a learning resource based on ontology information retrieval.	38 PSTs	<ul style="list-style-type: none"> Vision-based mobile augmented reality from the university campus (e.g., plants, flowers, trees) through scene detection, retrieval, superposition, visualization, and interaction 	AI vision-based mobile augmented reality (VMAR)	<ul style="list-style-type: none"> MobileNetV2 network: a lightweight convolutional neural network by Google for mobile devices 	n.d.	PSTs perceived the usability as good; it was preferred by younger users, and had a positive impact on learning. The average precision of retrieval based on keywords (97.46%) and ontology (90.85%) signified good performance.

Note. CDA = classroom discourse analyzer, DT = decision tree, FFTrees = fast-and-frugal trees, GBTD = gradient-boosted decision trees, KBSD = Knowledge–Behavior–Social Dashboard, ITEI = Indonesian Teacher Engagement Index, RF = random forests, NLP = natural language processing, SLBM-TAIS = service-learning-based module training AI subjects, SVM = support-vector machine, WISE = web-based inquiry science environment.

The authors state that the scientific conclusions are unaffected. This correction was approved by the Academic Editor. The original publication has also been updated.

Reference

1. Salas-Pilco, S.Z.; Xiao, K.; Hu, X. Artificial Intelligence and Learning Analytics in Teacher Education: A Systematic Review. *Educ. Sci.* **2022**, *12*, 569. [[CrossRef](#)]

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