



Uses of Artificial Intelligence in Higher Education



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Introduction

As the state of artificial intelligence (AI) rapidly develops, the question arises as to how far this emerging technology has come in improving higher education. There is considerable uncertainty and disagreement regarding how these tools should be used (Gerke, 2020, Cuéllar & Huk, 2022) and especially whether their use in education should be prohibited (D'Agostino, 2023). This study presents a systematic review of peer-reviewed literature on the applications of AI in higher education between 2019 and January 2023, replicating a study by Zawacki-Richter (2019) that explored literature on the topic between 2008 and 2018.

Zawacki-Richter used four labels for categorizing studies that are also used here:

- 1. adaptive systems and personalisation** – recommend personalized content, assist with teaching course content, use academic data to guide students toward better learning outcomes (Zawacki-Richter, 2019).
- 2. assessment and evaluation** - automated grading, assessment of teaching quality, evaluation of academic integrity (Zawacki-Richter, 2019).
- 3. profiling and prediction** - predictive modeling to forecast student retention, university admissions, final course grades (Zawacki-Richter, 2019).
- 4. intelligent tutoring systems** - create and teach course content, provide personalized feedback to students, oversee collaboration between learners (Zawacki-Richter, 2019).

Methods

ERIC (Proquest), Educator's Reference Complete (Gale OneFile), and Education Full Text (EBSCO) were included in the search. A team of four researchers screened the databases using the search string terms in Table 1, limited to peer-reviewed articles published after 2019.

Of the articles in the initial dataset, 105 were obtained through Education Full Text, 21 from Educator's Reference Complete, and 73 from ERIC. Sixteen duplicates were removed, leaving the dataset with 183 articles. These articles were reviewed again to determine whether they meet inclusion criteria, as well as whether they were categorized appropriately. Following the review process, 113 articles remained. These remaining articles are the basis for the results of the present study.

<u>Artificial Intelligence</u>	artificial intelligence OR machine intelligence OR intelligent support OR intelligent virtual reality OR chat bot* OR machine learning OR automated tutor OR personal tutor* OR intelligent agent* OR expert system OR neural network OR natural language processing
AND	
<u>Education level</u>	higher education OR college* OR undergrad* OR graduate OR postgrad* OR corporate training* OR professional training* OR vocational education OR adult education
AND	
<u>Student</u>	learn* OR student*

Table 1. Database search string.

Studies by Category

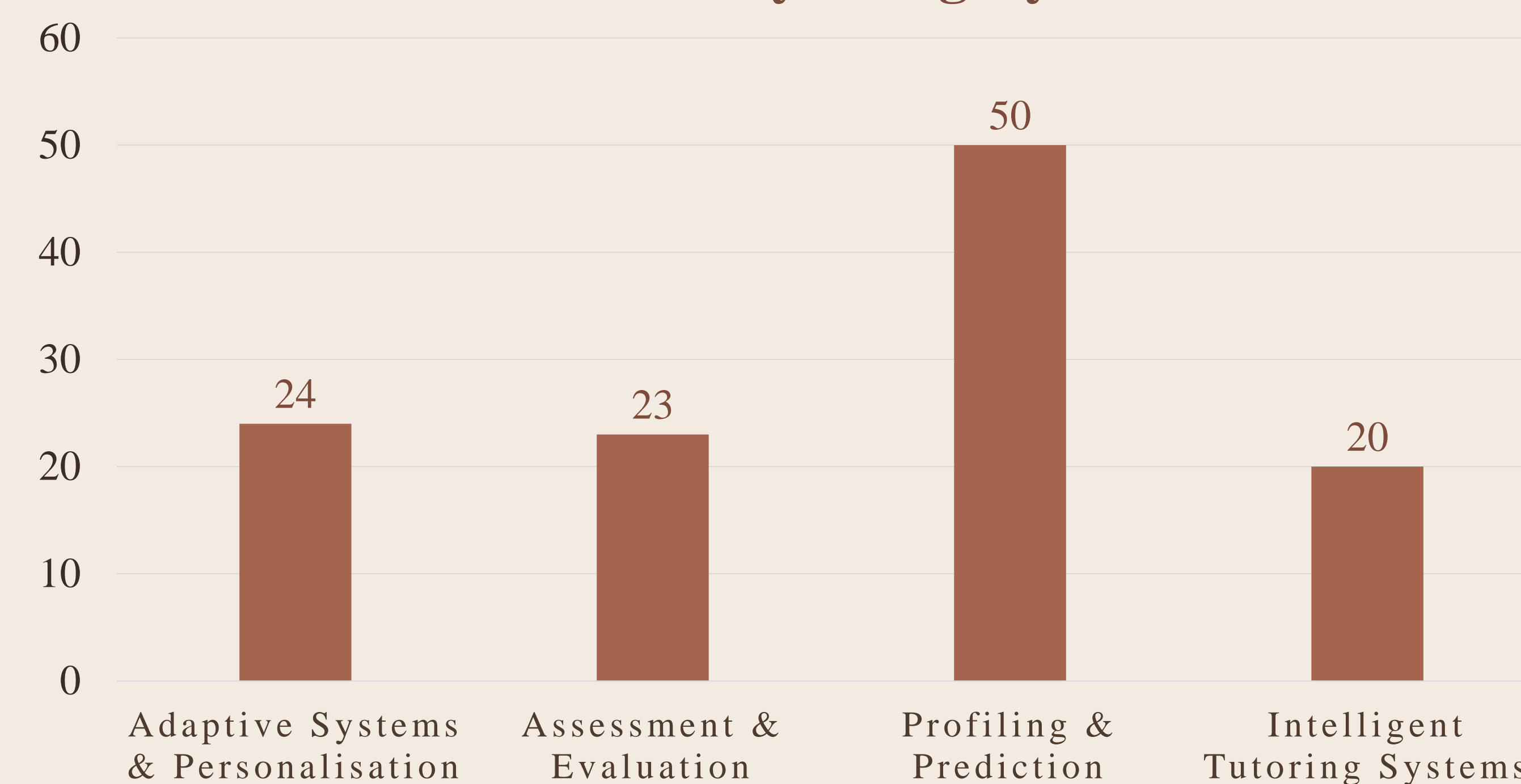


Figure 1. Number of studies in each category.

Quartile	SJR Rank	Journal	n
Q1	1.448	Educational Technology & Society	14
Q1	0.919	Education and Information Technologies	14
Q2	0.454	International Journal of Emerging Technologies in Learning	8
NA	NA	International Journal of Higher Education Research	5
Q4	0.178	International Educational Data Mining Society	5
		Articles from 43 other journals	67

Table 2. Top-ranked journals with most studies published.

Studies Published by Year

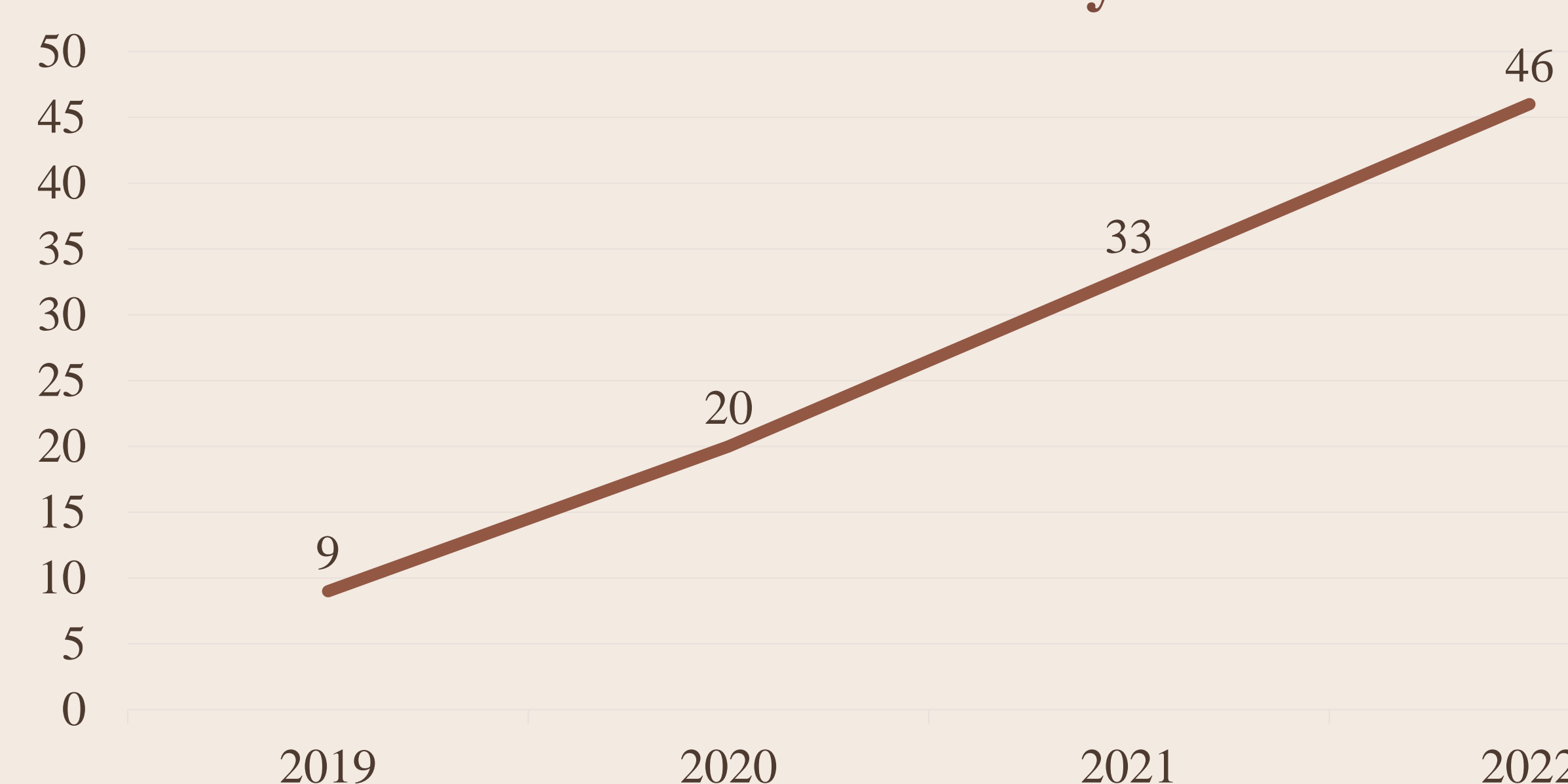


Figure 2. Number of studies published by year, from January 2019 to December 2022.

Country	n
United States	26
China	18
Taiwan	11
Turkey	6
United Kingdom	6
Canada	5
Japan	5
Others with 3 or less	28

Table 3. Studies by country.

Results

Profiling and prediction is the most common application of AI in higher education studied in the last four years. These studies typically used AI to predict student dropout rates, graduation rates, university admission rates, and detect at-risk students early. The predictive models were generally reported as effective or highly effective.

Adaptive systems research tended to focus on administration and personalized course content, particularly course recommender systems, practice systems, and teaching systems. Notably, research in Western nations primarily focused on administration (Barrett et al., 2019), while research in Asia focused on teaching (Lin & Mubarak, 2021).

Applications to assessment and evaluation commonly involved automated grading, including automated essay scoring. These tools are generally reported as moderately to highly effective.

Intelligent tutoring systems (ITS) studies most commonly took the form of the text-based chat bot that may offer personalized learning material to students, answer technical questions, and ask students practice questions. Common subjects taught with ITS include English as a foreign language ($n = 4$), computer science ($n = 3$), and healthcare ($n = 2$). Text-based chat bots (e.g. Replika) were often evaluated for conversational practice for students learning English (Lin & Mubarak, 2021). Overall, these studies generally reported the use of an ITS as effective.

Conclusions

Although the amount of research on the uses of AI in higher education is increasing every year, more research is still needed, particularly in exploring applications other than profiling and prediction. In particular, intelligent tutoring would seem to hold great promise for additional research, especially with the recent release of highly conversant and versatile chat bots such as chatGPT.

We predict that research on intelligent tutoring will quickly increase, possibly even overtaking profiling and prediction. The rapid proliferation of this technology will no doubt continue to fuel uncertainties about how and if this technology is suitable for educational use, possibly leading to broad changes in how students learn and how universities operate.

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