## COM00146M

## Department of Computer Science

## **Research Methods**

## FORMATIVE ASSESSMENT

## Word Count: 800

Part 1: 241 words

Part 2: 237 words

Part 3: 322 words

## Part 1: Research Questions and Hypotheses

In the field of computer science, research questions and hypotheses are fundamental [1]. "Artificial Intelligence Applications in K-12 Education: A Systematic Literature Review" addresses questions about the integration of AI in K-12 education [2]. The primary research questions posed in the study are:

"What are the applications of AI in education, and which type of AI has had significant benefits for education?", "How is the distribution of AI applications at different educational levels, and in which courses has AI been frequently involved?" and "Which technologies and devices are employed to implement AI in education?"

These questions aim to provide an overview of how AI is currently utilised in K-12 education and identify where AI has been most impactful. The study also seeks to uncover the technologies supporting AI integration in educational contexts.

These questions focus on enhancing educational outcomes through innovative AI applications. The hypotheses derived from these questions include: "AI applications in education significantly improve various educational outcomes, such as student performance and teaching efficiency," "AI is predominantly used in STEM-related courses at higher educational levels (middle and high schools)," and "Modern technologies such as machine learning, natural language processing, and intelligent tutoring systems are critical for implementing AI in education." These hypotheses provide a structured framework for investigating the role of AI in K-12 education, aligning with the study's objectives to identify effective AI applications and their distribution across educational levels and subjects.

## Part 2: Methodology and Methods Applied

The study employs a systematic literature review methodology to investigate AI integration in K-12 education. This approach involves several stages, including identifying relevant studies, screening for eligibility, and extracting and analysing data from papers. The methodology is designed to ensure a comprehensive and unbiased review of existing literature. The search strategy involves a thorough search of the Web of Science and Scopus databases, covering articles and conference papers published between 2011 and 2021. Keywords related to AI and K-12 education were used to retrieve relevant documents and the initial search yielded 2075 documents. After applying inclusion criteria (focusing on K-12 education and AI), 210 studies were selected for further analysis. Duplicate studies and those not meeting the criteria were excluded. For data extraction and analysis, the selected studies were examined on types of AI applications, educational levels, target courses, and technologies used. The data was organised and analysed to identify patterns and trends in AI applications in K-12 education. AI applications were categorised into four main groups: Student Performance, Teaching, Selection and Behaviour, and Other. Additionally, AI categories such as machine learning, intelligent tutoring systems, and natural language processing were identified. The study used both quantitative and qualitative methods to analyse the data. Statistical tests were employed to compare the prevalence of AI applications across different educational levels and courses, while thematic analysis was used to identify themes in qualitative data.

## Part 3: Critical Evaluation of Methods

The methods employed in this study are well-suited for a comprehensive review of AI applications in K-12 education. The systematic literature review methodology ensures a thorough and unbiased examination of existing research, providing a broad overview. The comprehensive data collection, structured screening, and diverse data sources are significant strengths. The use of multiple databases and a wide range of keywords ensures that relevant studies are not overlooked, and the systematic approach to screening and selecting studies enhances the reliability of the findings. Additionally, the inclusion of both journal articles and conference papers provides a comprehensive view of the current research landscape.

However, there are some limitations to the study. The exclusion of non-English studies means that relevant research in other languages may be missed. The reliance on published studies may introduce publication bias, as studies with positive results are more likely to be published [3]. Moreover, while the study provides valuable insights into AI applications in K-12 education, the findings may not be generalisable to all educational contexts due to differences in educational systems and resources.

The relationship between the research questions, methodology, and methods is integral to success [4]. The research questions are designed to explore specific aspects of AI in education, requiring methodologies that can capture both quantitative metrics and qualitative insights. The systematic literature review approach, combined with quantitative and qualitative analysis, ensures that the data collected is relevant and comprehensive [5]. This alignment enhances the research, enabling a thorough investigation of the hypotheses.

In conclusion, the research methods used in this study are carefully selected to address research questions within the context of K-12 education. The combination of systematic literature review and mixed-methods analysis provides a balanced and rigorous framework for data collection and analysis. While each method has its strengths and limitations, their complementary nature allows for a comprehensive investigation, contributing valuable insights to the fields of educational technology and AI.

# Bibliography

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| [1] | G. J. M. E. Barroga, “A Practical Guide to Writing Quantitative and Qualitative Research Questions and Hypotheses in Scholarly Articles,” *Journal of Korean Medical Science,* vol. 37, no. 16, 2022. |
| [2] | J. S. B. A. S.-N. S.-M. C. Mostafa Zafari, “Artificial Intelligence Applications in K-12 Education: A Systematic Literature Review,” *IEEE Access,* vol. 10, pp. 61905-61921, 2022. |
| [3] | K. L. M. C. S. Hopewell, “Publication bias in clinical trials due to statistical significance or direction of trial results.,” Cochrane Database of Systematic Reviews , 2009. |
| [4] | M. L. S. Carter, “Justifying Knowledge, Justifying Method, Taking Action: Epistemologies, Methodologies, and Methods in Qualitative Research,” *Qualitative Health Research,* vol. 17, pp. 1316 - 1328, 2007. |
| [5] | A. W. L. H. Andy P Siddaway, “How to Do a Systematic Review: A Best Practice Guide for Conducting and Reporting Narrative Reviews, Meta-Analyses, and Meta-Syntheses.,” *Annual review of psychology,* vol. 70, pp. 747-770, 2019. |