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A systematic review on the competences of human-AI collaboration

Youngjin YOO, Young Hoan CHO* & Jeewon CHOI
Seoul National University, South Korea
*yhcho95@snu.ac.kr

Abstract: Research on AI literacy has been conducted in the context of the essential skills needed for humans in a future society coexisting with AI. From a post-humanism perspective, existing AI literacy has been insufficient in presenting human competences for communication and collaboration with AI. The purpose of this study is to systematically derive the areas and competences essential for human-AI collaboration through a literature review. The related documents were collected from online academic databases, and a total of 32 papers were selected based on inclusion-exclusion criteria and quality assessment of the studies. Upon reviewing the selected literature, four main areas of human-AI collaboration competences were identified: 1) Understanding and utilizing AI, 2) Communication with AI, 3) Collaborative task regulation, and 4) AI ethics and socio-cultural values. This study offers theoretical implications for the development of AI curriculums, educational methods, and assessments to enhance human-AI collaboration competences.

Keywords: Human-AI Collaboration, Competence, Systematic review

1. Introduction

Globally, various efforts led by governments and international organizations are underway to advance AI-based education. In Korea, AI-based Intelligent Tutoring Systems (ITS) have been created and spread for individualized learning, guided by the Ministry of Education and various educational offices. This aligns with the global trend as AI becomes significant in education. AI literacy is considered an essential skill for humans to enhance. Previous studies on AI literacy have variation on the definition of AI literacy including know and understand AI, use AI, evaluate, and create AI (Ng et al., 2021). These studies commonly emphasized coding education, viewing the crucial skill for humans to understand and use AI (Kim et al., 2020; Ng et al., 2021). This perspective on AI literacy recognizes AI as a media or tool that humans handle. From a post-humanism perspective, AI is viewed as an actor interacting with humans in an equal relationship. Humans learn and thrive through communication and collaboration with AI (Kim et al., 2022; Park, 2020). In the Human-Computer Interaction (HCI) domain, research is also being conducted to develop AI systems that collaborate well with humans, reflecting a shift in understanding AI not merely as a tool but as a collaborative partner. If humans perceive AI as a collaborative partner, the competences required for humans would differ from the instrumental view of AI. Human-AI collaboration competences should be systematically enhanced through AI-related learning experience in AI education. In this regard, it is necessary to investigate the human competences for collaboration with AI. Therefore, this study aims to systematically review the literature on human-AI collaboration to identify the main areas and competences and delve into the educational implications for enhancing these competences.

2. Theoretical Background

The previous studies on human-AI collaboration competence can be broadly categorized into studies on AI literacy and AI collaboration. Firstly, studies on AI literacy emphasized cognitive competences related to understanding and utilizing AI. Common components

identified in AI literacy include understanding AI, utilizing AI, evaluating, and creating AI, and AI ethics. These studies highlighted the cognitive area of acquiring knowledge about AI and its application (Ng et al., 2021). Secondly, studies on AI collaboration include both cognitive and social competences in the collaboration process. For effective collaboration with AI, competences such as understanding AI, communication, positive attitudes towards AI, task regulation and reflection are essential. These competences included social competences that encompass interactions required in the collaboration with AI. In this study, human-AI collaboration competence is defined as the ability in an interactive process where multiple humans and AI systems reciprocally engage in joint activities aimed at achieving shared goals (Cañas, 2022; Markauskaite et al., 2022; Song & Cho, 2023; Terveen, 1995).
While various competences related to human-AI collaboration were presented, comprehensive definitions and descriptions including both cognitive and social competences were not provided. It is necessary to explore the specific areas and sub-competences of human-AI collaboration competence to enhance these competences through AI education.

3. Method

Following Newman and Gough's (2020) framework for qualitative systematic literature analysis, literature was selected from online databases using keywords such as 'human-AI collaboration', ‘competence', and 'AI literacy'. A total of 32 articles were selected based on inclusion-exclusion criteria and quality assessment of the studies. The researchers conducted coding and thematic analysis, constructing an initial outline with overarching themes. This outline was continuously revised throughout the analysis process. Through discussions among researchers, main areas and competence related to human-AI collaboration were derived, along with their respective definitions and meanings.

4. Findings

Human-AI collaboration competence derived from the systematic literature review contains 4 main areas and 11competences.

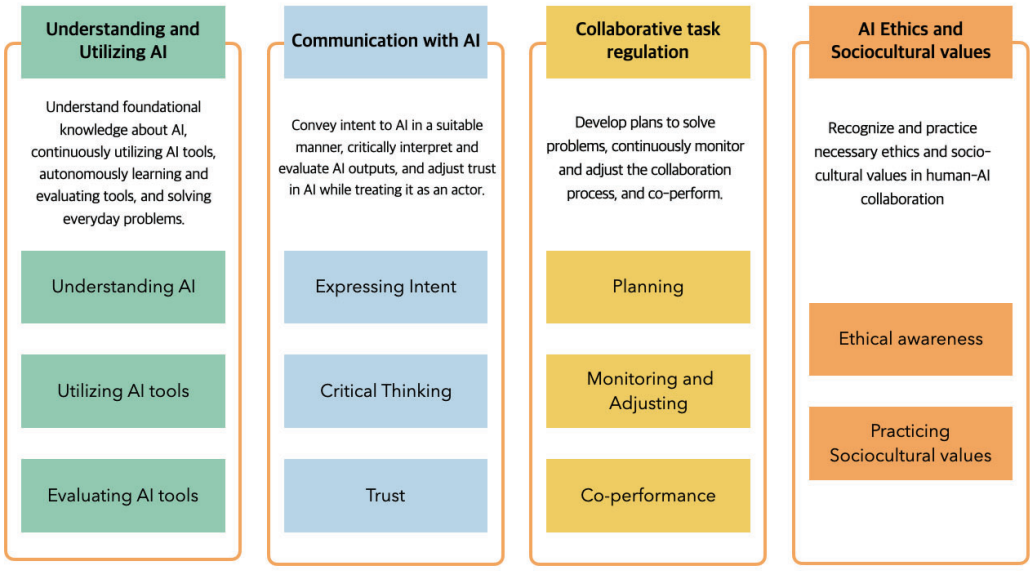

Figure 1. The Areas, Definitions and Competences of Human-AI Collaboration

4.1 Understanding and Utilizing AI

Understanding and Utilizing AI involves understanding foundational knowledge about AI, continuously utilizing AI tools, autonomously learning and evaluating these tools, and solving everyday challenges. Understanding AI is about comprehending AI technologies, their operational principles, and actively learning new AI tools. Utilizing

AI Tools is the process of selecting the right AI tools for specific tasks and actively employing them to solve problems. Evaluating AI Tools is the critical assessment of the performance and limitations of these tools, understanding their suitability for certain tasks, and recognizing their beneficial impact on daily life.

4.2 Communication with AI

Communication with AI involves conveying intent in a suitable manner for AI, critically interpreting and evaluating AI output, and adjusting trust towards AI. Expressing Intent is the ability to clearly express one's intentions to AI by inputting natural language or manipulating information in a proper manner for AI. Critical Thinking involves actively interpreting and evaluating the validity and potential inaccuracies of AI outputs. Trust is about adjusting between relying on AI and human judgment, recognizing the importance of human-AI collaboration, and treating AI as a valuable partner in the process.

4.3 Collaborative Task Regulation

Collaborative task regulation is about developing plans for task resolution, regularly monitoring, and adjusting the collaboration process, and co-performing. Planning is about allocating roles and responsibilities between humans and AI and creating plans for task resolution. Monitoring and Adjusting is the ability to proactively observe collaboration with AI, monitor the actions of both humans and AI for shared goals, and adjust plans and strategies accordingly. Co-performance is the ability to integrate AI outputs with one's own knowledge and collaboratively explore, develop, and execute optimal solutions with AI.

4.4 AI Ethics and Sociocultural Values

AI ethics and sociocultural values is to recognize and practice the necessary ethics and sociocultural values required in the process of collaborating with AI. Ethical Awareness is the ability to recognize ethical issues related to AI, take responsibility for the outcomes, and adhere to information security and ethics. Practicing Sociocultural Values is the ability to recognize diverse human-centered sociocultural values, evaluate the social impact of AI, and put those values into practice.

5. Conclusion

Human-AI collaboration competences are a fundamental ability for humans to live in the era of coexistence with AI. These competences not only enhance human learning and development by promoting effective collaboration with AI, leading to benefits such as improved problem-solving, increased efficiency, and better achievements in co-performing tasks but also foster a coexistence by trusting AI as significant actors in the evolving society. The findings of this study implied that Human-AI collaboration competences should be improved through educational supports such as AI-integrated curriculums, activity-based instruction with AI, and assessment of these competences with data from AI-related activity. It is necessary that the empirical research in educational setting should be conducted to implement these educational supports.

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