

Artificial Intelligence Competence: A Crucial Skill for the Digital Citizens

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Abstract

Artificial intelligence (AI) technology has made a significant impact on technological progress and has been integrated into various sectors and organizations. As a result, developing a workforce with knowledge and expertise in AI has become necessary. Skilled AI professionals will play a critical role in driving economic growth and competitiveness in the digital age. Therefore, it is essential to develop AI competency among various groups of people. Learning AI skill sets is necessary to facilitate effective collaboration between humans and machines in the learning process. Known for Life offers a range of knowledge, including technical skill sets, business skill sets, and skill sets for individuals that incorporate ethics, such as the ethical use of AI in education to enhance the learning experience and evaluate student performance. Understanding AI can help educators adopt modern teaching methods and prepare students for AI-related careers, but it is crucial to consider ethical implications.

Keywords: artificial intelligence competence, digital citizens, crucial skill

1. Introduction

The COVID-19 pandemic has brought uncertainty and pressure to many organizations, creating an unpredictable and ever-changing situation that has become a crucial part of organizational life. Prior to the pandemic, the strategic environment that organizations worldwide faced was commonly known as VUCA, which stands for Volatility, Uncertainty, Complexity, and Ambiguity. However, the outbreak of the COVID-19 virus has resulted in a situation that may not be well described by the VUCA framework. As a result, a new acronym, BANI, has been introduced to reflect the current strategic environment post-COVID-19. BANI stands for Brittle, Anxious, Nonlinear, and Incomprehensible, and represents a new, challenging, and threatening situation for organizations of all kinds, as well as for education at all levels (Axelsson & Fröjelin, 2023; Baskoro, 2022; de Godoy & Ribas Filho, 2021)

The current situation has led to a rapid development of technology and innovation in multiple areas. One of the most notable advancements is the adoption of online collaboration systems by various organizations, including government bodies, state agencies, industries, SMEs, and the education sector, ranging from early childhood to higher education. Among these technologies, Artificial Intelligence has made significant progress (AI).

Artificial Intelligence and Education Artificial Intelligence (AI) refers to a computer science field that simulates human intelligence, including algorithms that utilize machine learning, deep learning, natural language processing, and neural networks capable of learning and emulating complex human abilities, and even self-improvement (Russell et al., 2023). Currently, AI technology has influenced technological advancements and has been integrated into various sectors, such as healthcare, finance, transportation, and education. Experts with AI skills are crucial for the effective development, deployment, and maintenance of AI technology. In countries and businesses investing in AI development, there is a competitive advantage in the global economy. AI-skilled workers play a vital role in economic growth and competitiveness in the digital age, which has significant implications for the labor market. The job market is changing, and organizations require personnel capable of designing AI systems for data analysis and decision-making. AI capabilities go beyond just creating AI; it also involves understanding the

impacts on various industries.

Educators can use AI to improve the learning experience, assess student performance, and adopt modern teaching methods, preparing students for AI-related careers. However, ethical considerations need to be taken into account since ethical concerns related to AI can be managed through AI abilities, ensuring that AI systems are responsible, transparent, and fair. UNESCO has created a cross-national framework that guides AI technology development and usage and provides ethical recommendations. These recommendations have been endorsed by the 193 member states in UNESCO's General Conference, following consultations and discussions with experts, developers, and stakeholders from around the world (UNESCO, 2023).

Recent advancements in AI suggest that automation will accelerate rapidly. This could potentially decrease labor costs and increase productivity. However, it is uncertain whether this will cause concerns about the possibility of AI creating content that is indistinguishable from human-generated content, or disrupting human-machine communication. This reflects a significant development that may have a substantial impact on the economy (Hatzius, 2023).

2. Artificial Intelligence in Thailand's Contexts

In 2020, Thailand was ranked 60th globally in terms of government readiness for artificial intelligence (AI), primarily due to the absence of a well-structured AI policy and implementation plan (Ministry of Higher Education, Science, Research and Innovation Ministry of Digital Economy and Society, 2022). With a notable surge in AI technology adoption, Thailand's National AI Development Plan aims to keep up with the increasing adoption of AI technology. The plan takes into account the AI policies and strategies of various countries, including those within the European Union and the 27 nations that have published their own AI strategies. This comprehensive plan includes promoting scientific research in AI, investing in AI talent development, preparing for the impact of AI on the workforce, fostering growth of the AI industry, ensuring ethical use of AI, establishing a robust data and digital infrastructure, integrating AI into the public sector, and striving for inclusive social well-being. The ultimate goal is to make Thailand an AI-ready nation (Ministry of Higher Education, Science, Research and Innovation Ministry of Digital Economy and Society, 2022)

Thailand's readiness in adopting Artificial Intelligence (AI) technology faces multiple challenges that require immediate attention. Developing AI skills within the workforce and across related fields is imperative, as there is a growing demand for AI expertise. It is also crucial to accelerate the understanding and development of core AI technologies tailored to Thailand's specific requirements. To promote economic growth, it is essential to apply AI across various industries, which will substantially enhance productivity and services. Building a comprehensive AI ecosystem that ensures seamless connectivity from inception to fruition is paramount. Lastly, it is pivotal to foster ethical, legal, and appropriate AI usage. To achieve this, ethical and legal frameworks should be established to guarantee the responsible and suitable utilization of AI technology (Ministry of Higher Education, Science, Research, and Innovation and the Ministry of Digital Economy and Society, 2022). Thailand's ability to embrace the transformative power of AI will depend on its strategic response to these challenges.

According to the analysis of Thailand's situation in various aspects regarding artificial intelligence (AI), it is clear that the country needs to prepare for several challenges to stay ahead of the advancing AI technology. These challenges highlight the fact that Thailand lacks the workforce in AI-related fields necessary to manage AI technology effectively and align it with the nation's requirements. Therefore, it is crucial to develop AI competencies among various groups of professionals, such as AI engineers, data scientists, government personnel, and businesses, as well as individuals in education and the general population. This article aims to explain the meaning and concepts associated with the AI competency framework and serve as a guideline for fostering these competencies among diverse groups in the future. The discussion draws inspiration from the "Artificial Intelligence Competency Framework," a collaborative project between Concordia University and Dawson College. It focuses on presenting the essential competencies of individuals in the three categories while addressing the ethical implications of AI.

3. AI Competency for the Modern World

The term "competency" has been defined by Bowden and Masters (1993). It is widely recognized in the field of management through the work of Boyatzis in 1991. Individuals with competency are those who possess the necessary skills to respond effectively to their environment. Competency includes both skills and motivational components that inspire. This implies that although having skills is necessary, it is not sufficient to define competency (Corral-Verdugo, 2002).

Competency entails the concept of an individual's abilities, which encompass fundamental traits such as

motivation, character, skills, self-perception, social roles, and knowledge. Consequently, competency represents a person's capacity to effectively execute a specific task to attain results by predefined criteria, utilizing their knowledge, skills, and personal attributes (Boyatzis, 1991; Office of the Secretary of Education Council, 2023; Royal Institute of Thailand, 2003). Competency manifests as the behavior illustrating an individual's aptitude in applying their knowledge, skills, and specific characteristics, whether it be in their professional endeavors or various situations, ultimately leading to success. Therefore, competency is the cumulative result of knowledge, skills, attitudes, and personal attributes that enable individuals to excel in their work, problem-solving, and life. Competent individuals are those who can accomplish their responsibilities effectively, often surpassing predefined standards and objectives, thanks to their utilization of their knowledge, skills, attitudes, and diverse characteristics. Competency is cultivated when individuals have the chance to apply their knowledge, skills, and characteristics in addressing problems across different situations, transforming them into proficient and self-assured individuals capable of completing a variety of tasks (Office of Secretary of Education Council, 2023). Conversely, the absence of competency is exemplified by individuals who possess knowledge but do not apply it or cannot apply it in various scenarios, skilled individuals unable to utilize their skills in diverse situations, or individuals with a positive attitude but fail to apply it in various circumstances, thus considered not competent.

3.1 Levels of Competency

Competency can exist at various levels depending on the necessity or requirements. In many aspects, we need to have a competency level that is sufficient to survive and thrive. However, in some cases, we need to have a higher level of competency. Therefore, to develop and assess competency, performance criteria must be established to determine at which level competency is required. For example, for the general population, it may be necessary to have competency in using the English language for communication at a basic level, meaning the ability to communicate on general topics to a reasonable extent. But for those who plan to study abroad, a higher level of competency is required, often with established standards. Higher competency levels require more advanced knowledge and skills. However, whether advanced knowledge and skills result in competency depends on the experience of applying that knowledge and skills, as well as personal attributes (Office of the Secretary of Education Council, 2013).

3.2 The Components of Competency

Competency, as per MacClelland's concept, encompasses six fundamental components (Inran, 2021). Knowledge, the first component, represents the information an individual possesses, whether acquired through personal understanding or diverse forms of education. The second component is Skill, which entails the proficiency gained through training and practice, enabling one to efficiently perform tasks. Self-concept, the third element, relates to the personal framework of thoughts, values, and convictions, influencing how one interprets various subjects.

The fourth component is Traits, encompassing personal characteristics, attitudes, behaviors, and unique abilities, shaping an individual's personality. Attitude, the fifth part, involves the interpretation of thoughts, perspectives, beliefs, and foundational principles that impact one's words, actions, and behaviors. Finally, the sixth component, Motivation, comprises the driving factors that attract and stimulate individuals to take action willingly. These six components collectively constitute an individual's competency (Inran, 2021).

3.3 The Meaning of Artificial Intelligence Competency

Artificial Intelligence (AI) has become a topic of public interest, with key organizations such as UNESCO closely monitoring its impact and changes. They guide policy development and practices related to AI. UNESCO emphasized the importance of AI in achieving the education goals for 2030. They recognized the emergence of "a set of AI learning skills necessary for efficient collaboration between humans and machines." UNESCO recommends educational institutions enhance AI knowledge across all levels of society (UNESCO, 2023).

Through a collaborative initiative between Concordia University and Dawson College, an Artificial Intelligence Competency Framework, known as the "Artificial Intelligence Competency Framework: A Success Pipeline from College to University and Beyond," was developed (Blok et al., 2021). This framework is designed to support students' transition from college to university and facilitate lifelong learning. Its primary goal is to offer adaptable tools for educators, program developers, and various stakeholders. It categorizes AI competencies that can be applied in diverse higher education settings to address immediate needs while allowing for future adjustments and expansions. The AI competency framework was developed through extensive consultations with subject matter experts, instructional designers, and program development specialists. It serves as a valuable resource for curriculum development, striking a balance between technical, business, and human domains, in addition to ethical considerations. These competencies are structured as modular knowledge sets, making it possible to tailor them to

specific program objectives. This flexibility is particularly important when facing various challenges, including the ongoing impact of the pandemic.

This marks the beginning of a new phase in innovation and addressing the challenges in education in the era of AI. The goal of this AI competency framework is to structure the core competencies, comprising knowledge, skills, and abilities. AI practitioners must specialize in technical, business, and human aspects. Ethics is an integral part of these three core areas. This framework operates within the context of the Montreal AI Ethics Institute.

4. Artificial Intelligence Competency Framework

The Artificial Intelligence Competency Framework is an essential tool for educational institutions that offer courses related to Artificial Intelligence. It is designed to serve educators, instructional designers, and curriculum developers in creating a comprehensive and effective curriculum. The framework outlines a set of fundamental competencies that are necessary for AI professionals across various domains. These competencies are categorized into three main categories: Technical, Business, and Human. Each category includes a broad knowledge scope, such as Data, Mathematics and Statistics, and Programming, and specific subtopics referred to as Focus Area Themes. These themes help to further categorize competency issues into relevant subjects. For example, under the Data category, additional information is provided to help learners understand the subject better. Each competency set comprises a combination of knowledge, skills, and core abilities, accompanied by a set of sub-competencies that complement the core competencies.

I) Technical Domain

The Technical Domain Competency Framework is an essential guide tailored for AI professionals directly engaged in artificial intelligence. This includes machine learning engineers and data analysts who possess the skills to assess data for AI or apply data obtained from AI in practical contexts. It is structured into seven core areas, as outlined in Table 1. These competencies encompass a broad spectrum, including data comprehension, legal and ethical considerations, data management, presentation, storage, preprocessing, mathematics proficiency (including statistics, calculus, and numerical methods), software and database development, algorithm expertise related to supervised and unsupervised learning, and neural networks. Additionally, it covers parallel and cloud computing and the use of programming languages, libraries, and frameworks such as Python, R, Java, Julia, NumPy, Pandas, Matplotlib, SciPy, Matlab, GNU Octave, Pytorch, Tensorflow, Keras, Scikit-learn. These competencies are indispensable for AI professionals operating across diverse technical domains.

II) Business Domain

Business Competency Framework It is a competency framework used for business groups that use artificial intelligence in their business. AI may be applied to project management in various areas. There are 3 main focus areas: 1) initiatives for using artificial intelligence and project planning 2) initiatives for artificial intelligence and adaptation (AI Initiative and Project Scaling) 3) Artificial intelligence technology (AI Technologies) Each aspect has the following details.

1) Initiative for the use of artificial intelligence and project planning There are sub-competency groups. That involves applying AI to manage data and define project scope. Business development cooperation development Basics of using AI and managing project budgets with AI and technology, with competencies related to 1) selecting AI to suit various situations 2) assembling technical and interdisciplinary teams within the agency 2) applying AI to support pre-sale activities 3) Application of AI to create business opportunities 4) Application of AI to analyze costs according to project requirements.

2) Artificial intelligence initiatives and project scaling It must have key competencies related to 1) assessing the quality and readiness for use of data 2) being able to apply artificial intelligence to overcome existing and future obstacles 3) being able to apply intelligence Developed for managing external business stakeholders and other related business stakeholders 4) Application of AI to manage documentation processes related to customer trading 5) Integrating technical knowledge related to AI Use for management Including calculation of related costs.

3) Artificial intelligence technology There must be main competencies related to 1) applying AI for managing the integration of project requirements regarding the basic context of the project, such as human resources, data, infrastructure, including various sponsors, including increased skill development plans; 2) Applying Use AI to create appropriate project implementation plans. 3) Apply AI to find solutions to problems related to organizing data to deliver projects. Knowledge management model Includes transferring knowledge with stakeholders. 4) Applying AI to analyze the technological and business context of partners, including creating partnerships to work together. 5) Selecting technology or cloud systems that are appropriate for the organization.

III) Human Domain

The human competency framework consists of three core competencies: 1) Innovation, 2) Teamwork, and 3) Professionalism. (Professionalism) which has another set of 6 sub-competencies consisting of 1) Empathy (Empathetic Approach), 2) Thinking Process (Ideation Process), 3) Communication (Communication), 3) Goal Setting (Goal Setting) 4) Problem Definition (Problem) Definition), 5) Prototyping and Testing, and 6) Lifelong Learning There are examples of related competencies such as 1) applying AI to identify objectives for solving problems, including social dimensions related to language and culture; 2) being able to apply AI to solve problems that occur to oneself; 3) AI can be used to work together as a team. AI can be applied to set business-related objectives and track progress based on results. 5) Deciding on solutions by applying AI to work. For the future to continue 6) Apply AI for communication and teamwork, and 7) Be able to present information using storytelling techniques. Table 1 below illustrates the core competency framework for AI competencies across all three areas.

Table 1. Artificial intelligence competency framework

Technical	Business	Human
1. Data		
2. Mathematics and Statistics		
3. Programming	1. AI Initiative and Project Planning	1. Innovation
4. Machine Learning	2. AI Initiative and Project Scaling	2. Teamwork
5. Deep Learning	3. AI Technologies	3. Professionalism
6. Infrastructure		
7. Libraries and Frameworks		

Note. Source: (Blok et al., 2021)

4.1 The Importance of the AI Competency Framework

Artificial intelligence (AI) competency is important in three areas: technical, business, and human. These competencies cover various groups of people who are involved in AI development, those who use AI for business purposes, and those who use it in their daily lives. However, the context of use is different for each individual and must consider moral and ethical principles.

The developers responsible for creating AI systems (machine learning and deep learning) must possess a comprehensive understanding of data, mathematics, and statistical programming. Additionally, they should be proficient in programming languages such as: Python, R, Java, and libraries and frameworks such as Numpy, Pansdas, Matplotlib, Scikit-Learn, Keras, etc. In order to tackle certain tasks, a group of individuals with related development abilities can be brought together to work as a team. For business groups, this is done in order to carry out specific tasks that help the organization achieve its objectives. The use of artificial intelligence technology in project planning, budget and cost management, and sales of products and services to stakeholders is quite common. It can be customized to fit the needs of the agency or organization and to improve cooperation between business partners. This involves selecting the right technology for the organization and deploying appropriate innovations. The applications are both specialized and professional in nature.

4.2 Guidelines for Promoting the Use of Artificial Intelligence for Teachers and Students

As for the field of education, there will always be new technologies emerging, some of which can be applied and some of which are rejected from use. This is a problem with the use of innovative technology in education (Tatnall, 2020) from the perspective of teachers. There are several new technologies, such as AI tools, that are relevant to education and are very new for teachers. Teachers can use it to improve student learning outcomes. Teachers may not have enough technical knowledge to use educational applications to facilitate teaching and learning. Therefore, teachers must develop their abilities to prepare for their abilities in artificial intelligence to use and teach AI in their teaching environment to support AI technology (Ng et al., 2023). Examples of applications of AI in conjunction with teaching and learning activities include applications to record data and analyze the data in the next step. This will be useful for analyzing these data to study student learning behavior, and then AI algorithms can be used to predict learning efficiency (Afzaal et al., 2021; Choi & McClenen, 2020; Ouyang & Jiao, 2021; Wang et al., 2022). Integrating AI into teaching systems in using it in this way, it will be personalized and can take information into better consideration in terms of the learning process (Singh et al., 2020; Tobarra et al., 2021).

Teachers or educators must be able to integrate new digital technologies, of which AI technology is a subset. To

support learning through technology, it is vital to engage in professional learning through the use of AI as an educational tool. Appropriate AI-powered technologies, such as adaptive learning systems, can be deployed to improve individual learning as it becomes possible to track results and understand students' learning including promoting online collaboration between students (Cavalcanti et al., 2021; Markauskaite et al., 2022).

For students who will become teachers, they will need to develop AI competencies which are part of digital competencies. The research of Phitthayasene et al. (2020) will be related to the development of digital technology competencies of student teachers in Thailand. The objectives are to 1) synthesize digital technology competencies of teacher students in Thailand, 2) present guidelines for developing digital technology competencies of teacher students, and 3) study perceptions of digital technology competencies of teacher students in Thailand. The results of the synthesis of the digital technology competency framework for student teachers appeared, consisting of 8 areas: Competency Framework 1: Basic knowledge about digital media and technology. Competency framework 2: Access to information Competency framework 3: Creation and development of innovation Competency framework number 4: Be aware of digital media and use it safely. Competency Framework 5: Using digital technology in teaching Competency Framework 6: Communication and Coordination Competency Framework 7: Personal and Professional Development and Competency Framework No. 8: Ethics in the use of digital technology media. By guidelines for developing digital technology competency of teacher students Sorting the competencies according to the learning steps of Bloom Taxonomy (Bloom Taxonomy Revised, 2001) is divided into 3 areas: 1) Cognitive aspects, 2) Range skills, and 3) Affective skills. There is an average score of students' perception of digital technology competencies. Teacher each area consists of 1) a competency framework related to information access, 2) a competency framework related to the use of digital technology in teaching, and 3) a competency framework related to basic knowledge of digital media and technology. All three areas had a high average level of perception.

For the students: Cultivating artificial intelligence competencies in students can help them adapt to the rapidly developing intelligence era. By adjusting the curriculum to include relevant and appropriate applications of artificial intelligence for basic education, and cultivating students' competencies through such a curriculum. Education should not only consider the current situation. But it also considers the future. Learning AI helps students embrace the challenges posed by the intelligent era (Huang, 2021). AI education for students should start in childhood. From kindergarten to high school this gives students an understanding of AI from a young age. It also allows students to explore their interests and be inspired to apply AI to their education and careers. Therefore, students who learn from childhood will not only be AI users but will also be shaped to become creators in the future. Starting with students being able to recognize and understand the basic functions of AI and its use. AI applications, which are considered an essential component of digital literacy for every citizen, and students must be promoted to have knowledge and understanding of how AI can be used and evaluated. Finally, despite many concerns, students at a young age must be able to understand the basic functions of AI and promote this understanding through age-appropriate activities (Kong et al., 2021; Su et al., 2023; Yang, 2022).

Ng et al. (2021) created a guideline for developing individual artificial intelligence competencies. By comparing it with Bloom's taxonomy (knowing and understanding use, apply, evaluate, and create) in the development of AI competency, details related to ethics in the use of AI have been added by synthesizing definitions for each step: 1) Know and understand AI, which involves knowing and understanding basic functions and methods for using AI applications. 2) Use and apply AI involves the use of knowledge, concepts, and applications for different situations. 3) Evaluate and create AI involves using higher-level thinking skills, such as estimating, predicting, and designing applications. 4) AI ethics are about fairness. Responsibility, transparency, ethics, and safety from the use of AI by Touretzky et al. (2019) summarized the abilities and skills that everyone should learn about AI in terms of basic concepts including perception, representation, and reasoning: learning, natural interactions, and social impact.

5. Conclusion

In summary, AI has far-reaching capabilities that can benefit individuals, organizations, and countries across various sectors of society. It can help address ethical, economic, and social challenges while harnessing its potential. It's important to note that AI was not created to replace human jobs, but it's crucial for people to acquire AI skills to avoid unemployment. This article aims to promote a better understanding of AI competencies and their role in shaping the workforce of the future. The article also emphasizes the significance of AI in education and its impact on society and future generations. It's essential for individuals to understand how to use these technologies efficiently and ethically (Chiu, 2021) and what the consequences of technological advancements in widespread use are. It is possible that there are criminals who misuse technology for illegal activities. Therefore, it is important for every group of people to monitor the use of technology, whether it is by people with good or bad intentions. The

suitability of technology for use must be carefully considered. People should think about the purpose of using technology and may choose to use AI to solve problems that arise in daily life or in the future.

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Authors contributions

Supanee Sengsri was in charge of the study's design and analysis. Kheamparit Khunratchasana, along with Supanee Sengsri, worked on the development and revision of the manuscript. All authors have read and approved the final manuscript.

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