



Future education and artificial intelligence for education and training

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Abstract. *Education has evolved over time from the post-industrial society to the knowledge society in which information technologies and innovations have played a particularly significant role. In the knowledge society, education has seen a new progression, shifting from education based on dogmatic instruction to learner-centered education, focusing on skills and learning outcomes. Thus, along with the society we live in, teaching methods and assessment techniques in education have evolved. They have transitioned from learning that emphasized the passive participation of students to placing the student at the center of the teaching and learning process. Furthermore, the demand for skills and the supply of training have undergone adaptations in line with technological advancements. The landscape of education and training is undergoing a transformative shift as Artificial Intelligence (AI) becomes an integral player in shaping the future of learning. Understanding the profound impact of AI in education is essential for realizing its full potential in shaping the global citizens of tomorrow.*

Keywords: *Education, Competence, Competency-based Education, Artificial intelligence.*

JEL: I21, O33.

1. Introduction

The world of education is undergoing a profound transformation, driven by the integration of cutting-edge technologies, particularly Artificial Intelligence (AI). The symbiotic relationship between AI and education has the potential to revolutionize the way we learn and teach, making education more personalized, accessible, and effective. In this era of rapid technological advancement, the role of AI in education and training is poised to shape the future of learning.

As we stand on the cusp of this educational revolution, it is crucial to explore the multifaceted ways in which AI is influencing and enhancing the educational landscape. This exploration encompasses everything from personalized learning experiences and adaptive assessments to AI-driven tutors and the global accessibility of education. AI is not merely a tool but a transformative force that empowers both learners and educators.

This journey delves into the various dimensions of AI in education, from the classroom to online learning platforms, from early childhood education to professional development. It unravels the potential for AI to cater to diverse learning needs, promote lifelong learning, and address global educational challenges.

The integration of AI into the field of education represents a transformative leap in the way we learn and teach. The benefits of AI in education are numerous and far-reaching, promising to revolutionize the educational experience for learners of all ages and backgrounds. AI's ability to personalize learning, adapt to individual needs, and foster innovation has the potential to unlock new horizons in education.

Moreover, this exploration acknowledges the ethical considerations and challenges that arise as AI becomes an integral part of education. Questions about data privacy, equity, and the human touch in education are increasingly pertinent as AI systems become more sophisticated.

Starting from these considerations, this article aims to present the evolution of the concept of competence over time, including the analysis of the new competency framework for the year 2030 developed by the OECD, by highlighting the exceptionally important role that artificial intelligence will play in the development of competencies.

From a structural perspective, the article will consist of four sections: an introduction in which the exceptionally important role of analyzing the concept of competence in relation to the evolution of artificial intelligence will be discussed.

In the following sections, we will refer to the evolution of competencies over time and the evaluation of the new competency framework developed by the OECD, as well as the role of artificial intelligence in competency development.

The final section, the conclusion, will contain the main recommendations and arguments regarding the future of education and the role of artificial intelligence in the development of the educational process.

The research methodology will include investigative methods such as a literature review in the field to identify how the concept of competence has evolved over time, from the earliest attempts to define the concept to the new competency framework for 2030, as well as the role of artificial intelligence in building competencies for the future.

2. The evolution of "competence"

The concept of "competence" underlies the relationship between the demand for competencies and the supply of training in the labor market, as competence is a measurable capacity required for efficient performance (Hoge, Tondora, & Marrelli, 2005).

The evolution of the concept of competence can be traced over time by considering the following (Wilcox, 2012):

- 1. Historical Roots:** The concept of competence can be traced back to ancient civilizations. For example, the Chinese Empire used civil service exams to assess individuals' qualifications for government positions over 3,000 years ago.
- 2. Craftsmanship and Apprenticeship:** In medieval times, competence was closely linked to craftsmanship and apprenticeship. Individuals were expected to develop the specific skills required for effective job performance by working with master craftsmen.
- 3. Industrial Revolution and Skills:** The Industrial Revolution brought significant socioeconomic changes, and the need for a skilled workforce became increasingly important. The study of work, jobs, and the skills required in various sectors emerged during this period.
- 4. Scientific Management:** In the early 20th century, Frederick Winslow Taylor, known as the "father of scientific management" made significant contributions to the development of management thinking. His work emphasized efficiency, division of labor, and systematic time-and-motion studies, all of which were associated with the rise of the concept of competence.

5. **Psychological Perspective:** The field of psychology began to play a role in the development of the competence concept. Psychologists like David McClelland explored the idea of competency and its relevance in human behavior and work performance.
6. **Competency Models:** Over time, the concept of competence evolved to include competency models, which are frameworks that outline the specific skills, knowledge, and behaviors required for success in a particular role or field. These models are widely used in human resource management and workforce development.
7. **Competency-Based Education:** In the field of education, competency-based education (CBE) emerged as a pedagogical approach that focuses on mastering specific competencies rather than traditional grades or time-based learning. CBE is particularly relevant in higher education and vocational training.

Fredrick Winslow Taylor, often referred to as the “father of scientific management”, is associated with the development of scientific management principles, which were influential in the field of competencies. Scientific management, a management theory developed in the early 20th century, focused on optimizing workplace efficiency through the careful analysis of work processes, standardization, and the use of time-and-motion studies (Uddin, Hossain, 2015).

While Taylor's work primarily focused on the efficient organization of work tasks and labor, it laid the groundwork for the development of competencies in the sense that it emphasized the need for specific skills and knowledge to perform tasks effectively. Competencies became an essential aspect of human resource management and workforce development, as they are related to the skills and abilities required for various job roles and tasks within an organization.

In summary, Taylor's scientific management principles played a foundational role in shaping the importance of competencies in the modern workplace, as they underscored the significance of skills and knowledge in achieving efficient and productive work outcomes.

Later, with the emergence of scientific management, when Taylor (1911) proposed greater division of labor, competence developed in association with the need for skills to undertake various activities in the workplace (Hoge, Tondora, & Marrelli, 2005).

In 1959, the American psychologist White first used the term “competence” in his paper titled “Motivation Reconsidered: The Concept of Competence”. He defined

competence as those personality attributes imperative for superior performance and high motivation. (Salman& Ganie & Saleem, 2020).

The evolution of the concept of “competence” has not only shaped the industrial sectors in terms of the workforce but has also influenced the field of education, laying the foundation for a paradigm shift toward competency-based education.

Edward L. Thorndike was an American psychologist known for his significant contributions to the development of learning theory and the understanding of competencies. One of Thorndike's most notable theories is the theory of connections, which argues that learning is the result of forming and strengthening connections between stimuli and the responses provided by an organism.

In the context of education and learning, Thorndike made important contributions regarding the development and assessment of competencies. He promoted the idea that learning and skill development could be objectively assessed and measured, which contributed to the development of competency testing methods (Donahoe, 2000).

John Dewey's work and educational philosophy have influenced the development and understanding of competencies, particularly in the context of education. While Dewey may not be considered the sole inventor of competencies, his ideas have contributed to the foundation of competency-based education.

Dewey emphasized the importance of experiential learning, problem-solving, and active engagement in the learning process. These concepts align with the development of practical skills and knowledge, which are key components of competencies. Dewey's ideas on child-centered learning and fostering critical thinking skills have had a lasting impact on modern educational practices, including competency-based education (Pappas, 2023).

In competency-based education, the focus is on the mastery of specific skills and knowledge rather than traditional time-based models. Students demonstrate their competencies through practical application and assessments. Dewey's emphasis on learning by doing and making education relevant to students aligns with the principles of competency-based education, where learners acquire and apply specific skills and knowledge to real-world situations.

The development and implementation of competencies have been influenced by various fields and disciplines, including psychology, education, human resource management, and organizational development. While specific models and

approaches may have been developed by individuals or organizations, the overall concept of competencies is a collaborative and evolving effort that has been shaped by the needs of different sectors and industries.

In essence, competencies are the result of a collective effort over many years, and no single individual or inventor can be credited with their creation. They have become a fundamental framework for assessing and developing skills and knowledge in education and the workforce.

The concept of “competence” is the central element in defining learning outcomes and underlies the development of a “competency-based” curriculum. The notion of “learning outcomes” is not new in education and professional training, what is now evident is the prominence it has gained in national and European education policies and in any discussion regarding curriculum reform.

The relationship between learning outcomes and competencies is a complex subject of debate. The terms “competence” is used in association with learning outcomes in various countries in many different ways.

The Organization for Economic Co-operation and Development (OECD) defines competence as the “ability to consistently and effectively perform tasks to produce a desired outcome” (OECD, 2002). This definition emphasizes the key elements of capability and consistent performance in achieving specific results. Competence, as defined by the OECD, is a central concept in the organization's work related to education, skills, and workforce development, as it plays a crucial role in ensuring individuals are prepared for the demands of the global economy.

The DeSeCo (Definition and Selection of Competencies) project is an initiative that aimed to define and select key competencies for the 21st century. It was led by the Organization for Economic Co-operation and Development (OECD) and conducted over several years.

The primary goal of the DeSeCo project was to identify the competencies and skills that individuals need to thrive in a rapidly changing, knowledge-based society. The project sought to address the evolving demands of the labor market, the increasing importance of global interconnectedness, and the need for individuals to adapt to a dynamic and complex world (OECD, 2002).

The DeSeCo project identified and defined a set of key competencies, often referred to as “21st-century competencies”. These competencies typically include skills like critical thinking, problem-solving, creativity, digital literacy, communication,

teamwork, and adaptability, among others. The project's work contributed to the development of educational policies and practices that aim to foster these competencies in learners.

The DeSeCo project has had a significant impact on the field of education and workforce development by emphasizing the importance of these key competencies in preparing individuals for success in the 21st century. The competencies identified by the project continue to influence curriculum design, teaching methods, and assessments in many educational systems around the world.

Developed in the late 1990s and related to the Programme for International Student Assessment (PISA), the project for defining and selecting competencies (DeSeCo) groups key competencies into three categories (OECD, 2002):

1. Interactive use of tools (interactive use of language, symbols, and texts, interactive use of knowledge and information, technology use);
2. Interaction in heterogeneous groups (cooperation, teamwork, conflict management);
3. Acting autonomously (personal life and project plans, defense and advocacy of rights, interests, limits, and needs).

Undoubtedly, developments related to the European Framework for Key Competences for Lifelong Learning (2006), as well as the implementation of the European Qualifications Framework (2008), have had a decisive influence on curriculum development.

In this framework, the European Union recommended eight key competences for lifelong learning, which are also valid for higher education (European Commission, 2018):

1. Literacy competence.
2. Multilingual competence.
3. Mathematical competence and competence in science.
4. Technology and engineering.
5. Digital competence.
6. Personal, social and learning to learn competence.
7. Citizenship competence.
8. Entrepreneurship competence.
9. Cultural awareness and expression competence.

Competency-based education was introduced in America in the late 1960s as a response to the fact that students were not being taught the skills they needed for

the transition from school to active life. Competency-based education is based on six very important components (Nodine, 2016):

1. Explicit learning outcomes regarding the necessary requirements and skills (assessment standards).
2. A flexible time frame for mastering these skills.
3. A variety of instructional activities to facilitate learning.
4. Adaptive programs to ensure optimal guidance for learners.

A competence-based education framework, often referred to as Competency-Based Education (CBE), is an educational approach that centers on specific skills and knowledge that learners are expected to acquire and demonstrate.

Competency-Based Education (CBE) has the following characteristics, as found in the specialized literature (Wesselink, Giaffredo, 2015):

1. Clearly Defined Competencies: CBE is based on clear and well-defined competencies. These competencies specify what a student should know and be able to do by the end of the course or program.
2. Flexibility in Pace and Path: CBE offers flexibility for students in terms of the pace and path of their learning. Students can progress more quickly or slowly based on their level of preparation and abilities.
3. Competency-Based Assessment: Assessments are competency-based and indicate whether a student has achieved the specified objectives. There is no need to spend time learning material that students already master.
4. Personalization: CBE is tailored to individual student needs. Students can choose the competencies they wish to develop and receive support in doing so.
5. Project-Based and Practical Learning: CBE often involves projects, practical tasks, and issues relevant to the field of study. This helps students apply knowledge and develop practical skills.
6. Mentoring and Ongoing Feedback: Students receive regular feedback and have access to mentors or teachers to guide them throughout the learning process.
7. Use of Technology: CBE may involve online learning technologies to provide resources, instruction, and assessments. This allows for greater accessibility and flexibility.
8. Trust in Prior Knowledge and Skills: CBE acknowledges students' prior knowledge and skills and allows them to progress based on what they already know.
9. Quality and Standards Assurance: CBE programs are designed to ensure high standards of learning and assessment.

10. Formative and Summative Assessment: CBE includes both formative assessment (which guides learning) and summative assessment (which assesses final competency).

3. Developing competencies for the future

The evolution of competencies is a concept that refers to how skills, knowledge, and the ability to perform activities develop and change over time. This evolution can be influenced by changes in the work environment, technological advancements, new societal demands, and many other factors. In the context of education and personal development, the evolution of competencies is an important part of the learning and growth process. It may involve acquiring new skills, strengthening existing knowledge, and adapting to changes in the surrounding environment. The evolution of competencies is a continuous process that can contribute to improving individual performance and adapting to the changing requirements of the world around us.

The OECD Learning Compass 2030 identifies three “transformative competencies” that are considered essential for students to make meaningful contributions to society and help create a better future (OECD, 2019). These competencies are (OECD, 2019):

1. **Creating New Value:** This competency refers to the ability to generate innovative solutions and ideas that can address complex challenges and create positive change. It involves thinking creatively, being open to new perspectives, and finding novel ways to add value to society and the world.
2. **Reconciling Tensions and Dilemmas:** Students with this competency are adept at managing conflicts and dilemmas in an ethical and constructive manner. They can navigate and resolve opposing interests, values, and ideas, seeking common ground and finding solutions that balance diverse perspectives.
3. **Taking Responsibility:** This competency emphasizes a strong sense of personal and social responsibility. Students who possess this skill understand the impact of their actions on the world and are committed to making ethical and sustainable choices. They take initiative to contribute positively to their communities and the global society.

These transformative competencies are crucial for preparing students to engage in a rapidly changing and complex world. They enable individuals to adapt to new challenges, promote social harmony, and actively participate in building a more inclusive and sustainable future.

The competencies required for success in 2030 are expected to evolve in response to rapid technological advancements, changing workplace dynamics, and the shifting demands of the global economy. While it's challenging to predict specific competencies with absolute certainty, the following competencies are expected to be increasingly important in 2030 (OECD, 2018):

1. **Digital Literacy and Tech Skills:** Proficiency with technology, including artificial intelligence, data analysis, and digital tools, will be critical. This includes the ability to adapt to new technologies as they emerge.
2. **Adaptability and Resilience:** The capacity to adapt to change, handle uncertainty, and bounce back from setbacks will be highly valuable in a rapidly evolving world.
3. **Creativity and Innovation:** The ability to think creatively, generate novel ideas, and innovate will be essential in a dynamic and competitive environment.
4. **Critical Thinking and Problem-Solving:** Strong analytical skills and the ability to solve complex problems will remain in high demand.
5. **Emotional Intelligence:** The capacity to understand and manage emotions, as well as effectively collaborate with others, will be crucial, particularly in roles that involve interaction with people.
6. **Cultural Competence and Diversity Awareness:** With globalization, an understanding of different cultures and the ability to work with diverse teams will be important.
7. **Environmental Literacy:** Given the increasing importance of environmental sustainability, competencies related to understanding and addressing environmental issues are expected to be more significant.
8. **Health and Well-Being:** Skills related to maintaining physical and mental health will continue to be important as individuals seek to balance work and life.
9. **Cybersecurity and Data Privacy:** With the growth of online activities, competencies in cybersecurity and data protection will be critical.
10. **Interdisciplinary Knowledge:** Competencies that bridge multiple fields of knowledge, enabling individuals to solve complex, multifaceted problems, will be increasingly valuable.
11. **Lifelong Learning:** The willingness and ability to continuously learn, adapt, and acquire new skills throughout one's career will be essential.

These competencies reflect a combination of hard and soft skills that are expected to be in high demand as the world continues to change. Preparing for the future job market will require a commitment to ongoing learning and development to stay relevant and competitive.

4. The role of AI in shaping education and training

Artificial Intelligence (AI) is playing an increasingly significant role in education and training across various levels, from K-12 schools to higher education and professional development.

We can summarize the role of AI in the education and training of the future by referring to the following aspects (OECD, 2018):

1. **Personalized Learning:** AI can analyze a student's learning patterns and preferences, allowing for the creation of personalized learning pathways. This tailors instruction to an individual's strengths and weaknesses, promoting more effective learning.
2. **Adaptive Learning:** AI-driven adaptive learning platforms can adjust the difficulty of assignments and content in real-time, ensuring that learners are appropriately challenged and not overwhelmed.
3. **Assessment and Feedback:** AI can automate the grading of assignments and exams, providing quick and consistent feedback to students. It can also analyze this data to identify areas where students may need additional support.
4. **Virtual Tutors and Assistants:** AI-powered chatbots and virtual tutors can provide instant answers to student queries, offer explanations for difficult concepts, and assist with homework.
5. **Language Learning:** AI-driven language learning platforms can offer speech recognition and pronunciation feedback, making language acquisition more interactive and effective.
6. **Early Intervention:** AI can identify at-risk students by monitoring their progress and engagement. Educators can then intervene with additional support to help struggling learners.
7. **Content Creation:** AI tools can generate educational content, including lessons, quizzes, and even textbooks. This can help educators save time and ensure the availability of up-to-date materials.
8. **Teacher Support:** AI can help educators by providing insights into student performance and suggesting strategies for improving learning outcomes. It can also assist with administrative tasks like scheduling and grading.
9. **Professional Development:** AI-powered systems can offer personalized professional development opportunities for educators, helping them stay current with best practices and new teaching methods.
10. **Career Training:** In the corporate world, AI is used for employee training and development. AI-driven simulations and virtual reality can create realistic training scenarios for various industries.

11. **Accessibility:** AI can enhance accessibility for learners with disabilities. For example, it can provide real-time captioning for deaf or hard-of-hearing students and convert text to speech for visually impaired learners.
12. **Data Analytics:** AI can analyze vast amounts of data to identify trends and patterns in education. This data can inform decision-making at institutional and policy levels.
13. **Ethical Considerations:** AI in education also raises ethical questions related to data privacy, equity, and the potential for bias in algorithms and decision-making.

As AI continues to advance, its role in education and training will likely expand, improving the quality and accessibility of learning opportunities. However, it's important to strike a balance between the benefits of AI and the need to address ethical concerns and ensure that education remains a holistic and human-centered endeavor.

5. Conclusions

The future of education will be increasingly intertwined with the use of Artificial Intelligence (AI) for education and training. As found in the study “Future of Education and Skills 2030: Conceptual Learning Framework. Education and AI: Preparing for the Future & AI, Attitudes and Values”, developed by the OECD, the main trends and conclusions regarding the future use of artificial intelligence in education and training are as follows (OECD, 2018):

1. **Personalized Learning:** AI will continue to enable personalized learning experiences, where educational content and pace are tailored to individual students' needs and abilities. This can help students learn at their own pace and level.
2. **Adaptive Assessment:** AI-driven assessments will become more sophisticated, providing real-time insights into students' progress and areas where they need additional support. This data can inform educators and students alike.
3. **AI Tutors and Chatbots:** Virtual tutors and AI-powered chatbots will become even more advanced, providing instant assistance to students, answering questions, and offering explanations for complex topics.
4. **Global Access to Education:** Online education platforms, supported by AI, will offer educational opportunities to individuals worldwide, breaking down geographical barriers to learning.
5. **AI-Enhanced Curriculum:** AI can generate content and curricula that adapt to changes in the job market and technology, ensuring that learners acquire the most relevant skills.

6. Education Analytics: AI-driven data analytics will provide insights for education administrators, helping them make data-informed decisions on curriculum development and resource allocation
7. Professional Development: AI will offer personalized professional development opportunities for educators, helping them stay current with best practices and educational research.
8. Education Gamification: Gamification and AI-powered educational games will make learning more engaging, particularly for younger students.
9. Addressing Learning Gaps: AI can identify and address learning gaps, ensuring that no student is left behind. It can provide targeted interventions for struggling learners.
10. Emerging Technologies: AI will work in conjunction with other technologies, such as virtual reality (VR) and augmented reality (AR), to create immersive learning experiences.
11. Ethical Considerations: The ethical use of AI in education will be a critical consideration, particularly regarding data privacy, bias mitigation, and ensuring equity in access to AI-driven education.
12. Teacher-Student Collaboration: AI will complement the role of educators, allowing them to focus more on mentoring, coaching, and fostering critical thinking skills in students.
13. Lifelong Learning: AI will play a crucial role in supporting continuous learning throughout one's life, helping individuals adapt to changing job requirements and societal shifts.
14. Global Collaboration: AI can facilitate global collaborations in education, connecting students and educators from different parts of the world for collaborative projects and cross-cultural learning.

The future of education will involve a fusion of human and AI-driven approaches, with AI enhancing and expanding educational opportunities. It is essential to consider the responsible and ethical use of AI, data privacy, and ensuring that the benefits of AI in education are accessible to all learners.

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