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Learner Engineering in the Context of Digitalization: A Sociological-Educational Approach to Pedagogical Transformations

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Abstract:
This study examines learner engineering in the context of digitalization from a sociological and educational perspective, with the aim of analyzing the pedagogical transformations generated by the digital revolution and their implications for the educational system. It begins by examining the broader context of digital transformations, with particular emphasis on the role of artificial intelligence, distance education, and digital platforms in reshaping learning environments and modes of knowledge production. It also investigates the impact of digitalization on educational institutions, particularly schools and universities, by highlighting changes in the roles of both teachers and learners and the transition toward an educational model based on interaction, self-directed learning, and the development of digital competencies. The study further discusses the concept of educational engineering as an approach to designing the educational process and integrating digital technologies in ways that enhance the quality and effectiveness of learning. Within a sociological-educational framework, it analyzes the nature of social interactions within digital learning environments and the resulting transformations in communication patterns and pedagogical relationships. It concludes that digitalization represents a significant opportunity to develop pedagogical practices and improve educational outcomes. At the same time, however, it raises challenges related to the digital divide, the qualification of human resources, and the need to ensure the responsible and effective use of modern technologies. Addressing these challenges requires a reconsideration of educational policies to ensure their alignment with the requirements of the digital society.

Keywords: Digitalization, learner engineering, pedagogical transformations, sociological-educational approach, artificial intelligence, distance education, digital platforms.

Introduction:

Over recent decades, the world has experienced rapid transformations driven by the digital revolution, which is no longer limited to the development of technological tools or the modernization of communication technologies. Rather, it has become a structural transformation that has reshaped patterns of life, production, communication, and knowledge acquisition. This development has contributed to the emergence of a knowledge-based digital society in which technology increasingly intersects with various social, economic, and cultural domains. Consequently, educational systems have faced unprecedented

challenges requiring a reconsideration of their philosophies, objectives, functions, and operational mechanisms. Within this context, education can no longer be understood merely as a process of knowledge transmission; it has become a dynamic space for the production and collaborative construction of knowledge, supported by the opportunities offered by digital technologies, artificial intelligence, electronic learning platforms, and distance education.

Digitalization has generated profound transformations within schools and universities, both in the organization of the educational process and in the nature of the roles performed by educational actors. The learner has shifted from the position of a passive recipient to that of a central actor in constructing their own learning, while the teacher's role has evolved from that of a transmitter of knowledge to a guide, facilitator, and designer of digital learning environments. Digital platforms, open educational resources, and intelligent systems have also introduced new forms of interaction, communication, and assessment. These developments have necessitated a reconsideration of traditional teaching methods and the concept of educational quality, while simultaneously redefining the boundaries of the pedagogical relationship between teachers and learners within an educational environment characterized by flexibility, openness, and continuous interaction.

Against this background, the concept of "learner engineering" has emerged as a contemporary concept reflecting the transition from educational engineering understood primarily as the organization of content and instructional tools toward a learner-centered approach. This approach involves designing educational experiences that take learners' cognitive, social, and psychological needs into account while fostering their autonomy, digital competence, capacity for self-directed learning, and ability to engage in lifelong learning. The success of the educational process is therefore no longer dependent solely on the quality of educational content or the effectiveness of digital media; rather, it is increasingly associated with the capacity to develop learners who can interact effectively with digital environments, manage their knowledge, and adapt to the rapid transformations imposed by the knowledge society.

From a sociological-educational perspective, these transformations cannot be understood independently of the changes affecting the nature of social relationships within educational institutions and digital spaces. Interactions between teachers and learners, as well as among learners themselves, increasingly occur through digital media that generate new forms of communication, authority, participation, and educational identity construction. Digitalization has therefore influenced not only the technological structure of education but also the reshaping of school and university cultures. It has transformed patterns of educational socialization and the mechanisms through which knowledge is produced and shared. Analyzing these developments consequently requires an approach that integrates both sociological and educational dimensions in order to understand their implications for educational practices and for the various actors involved in the educational process.

Accordingly, this article seeks to examine learner engineering in the context of digitalization from a sociological-educational perspective by addressing several key issues for analysis and discussion, with the aim of highlighting the major pedagogical transformations and the challenges facing educational

institutions in developing an educational model capable of responding to the requirements of digital transformation and achieving higher-quality, more equitable, and more effective education.

First: General Context:

- **Digital Transformations in Society:**

Digital transformation is one of the most significant phenomena to have reshaped human life over recent decades. Technology is no longer merely a set of supportive tools; rather, it has become an essential infrastructure influencing all domains of life.

1. Artificial Intelligence:

1.1. Concept of Artificial Intelligence:

Artificial intelligence is defined as a set of behaviors and characteristics exhibited by computer programs that enable them to simulate human intellectual capacities and patterns of functioning. Among its most important characteristics are the ability to learn, draw inferences, and respond to situations for which the machine has not been explicitly programmed. (Osama Abdelrahman, 2018, p. 20)

Artificial intelligence also refers to systems that exhibit intelligent behavior by interacting with their environment and taking actions—with a certain degree of autonomy—to achieve specific objectives. (Boucher, June 2020, p. 4)

Considering the applications most widely available today, artificial intelligence can be defined as systems that employ technologies capable of collecting data and using them to generate predictions, provide recommendations, or make decisions—with varying levels of autonomous control—and to select the most appropriate course of action for achieving specific objectives. (SDAIA, 2022, p. 8)

1.2. Classifications of Artificial Intelligence:

1.2.1 Super Artificial Intelligence:

This term is used to describe the development of artificial intelligence to a level at which the intellectual capacity of machines surpasses that of humans in performing certain tasks.

1.2.2 Strong Artificial Intelligence:

This term is used to describe the development of artificial intelligence to a level at which the intellectual capacity of a machine becomes functionally equivalent to that of a human being. Strong artificial intelligence is based on the proposition that a computer can be programmed to function like the human mind, to be intelligent in the fullest sense of the term, and to possess awareness, beliefs, and other cognitive states generally attributed exclusively to humans. Its principal characteristics include the ability to think and interact intelligently, solve problems, make judgments, plan and learn, and communicate. It should also possess consciousness, subjective ideas, emotions, and behavior. (Abdullah Moussa and Ahmed Habib Bilal, 2019, p. 28)

1.2.3 Weak Artificial Intelligence:

Narrow or weak artificial intelligence systems possess specific forms of intelligence that simulate intelligent behavior within a particular domain. One example is Apple's intelligent personal assistant, Siri. The application uses the Internet as an extensive database to answer users' spoken questions and engage

in conversations with individuals. However, it operates within a highly restricted and predefined scope. This limitation becomes apparent through the inaccurate responses generated when it is engaged in conversations for which it has not been programmed. (Moussa and Habib Bilal, 2019, p. 29)

1.3. Characteristics of Artificial Intelligence:

Artificial intelligence applications possess a range of characteristics that have made them valuable across numerous fields, including the following: (Asmaa El-Sayed Mohamed and Karima Mahmoud Mohamed, 2020, p. 23)

- Artificial intelligence applications enable devices and machines to analyze problems.
- Artificial intelligence applications enable devices and machines to recognize sounds and speech and manipulate objects.
- Some devices incorporating artificial intelligence are capable of understanding and analyzing inputs to generate outputs that effectively meet users' needs.
- Artificial intelligence applications are capable of continuous learning, allowing the learning process to become automated and self-directed without requiring constant monitoring or supervision.
- They are capable of processing vast amounts of information.
- They can identify similar patterns in data and analyze them more effectively than the human brain.
- They are capable of finding solutions to unfamiliar problems by drawing on their cognitive capabilities.

2. Distance Education:

2.1 Concept of Distance Education:

Distance education is an educational approach that relies on digital media such as the Internet, educational platforms, and email, enabling learners to attend lessons, complete assignments, and participate in discussions from any location.

Distance education is an educational process in which teachers and learners are geographically separated and manage their activities flexibly and with relative independence. Distance education therefore takes the form of online education and is closely associated with e-learning. It is based on information technology and Internet connectivity and constitutes part of what is known as computer-supported collaborative learning. (Vassilis Komis, 2013, p. 258)

Distance education is also defined as the delivery of educational materials to learners at their place of work or residence. This implies geographical separation between the learner and the teacher, such that meeting in a lecture hall is not considered the primary basis of their relationship. To compensate for the absence of direct face-to-face interaction, students acquire knowledge through modern educational media, thereby making higher education accessible to all individuals seeking to pursue it. (Al-Abadi Hashem Fawzi, 2008, p. 323)

2.2. Principles of Distance Education:

Distance education is based on a set of principles, the most important of which include:

- **The principle of accessibility:** This means that educational opportunities at the higher education level should be available to everyone, regardless of the spatial or objective barriers they may encounter. Distance education can extend educational opportunities to individuals who have been deprived of access to conventional education for educational, geographical, or social reasons, because of physical disabilities, or due to other obstacles. (Maha Abdel Majid, 2008)
- **The principle of flexibility:** This refers to overcoming barriers arising either from the educational system itself or from those responsible for its implementation, thereby enabling learners to receive education at any time and in any location.
- **The principle of reliability:** This refers to the extent to which academic programs and the qualifications they confer are appropriate for their intended purposes in comparison with other programs and qualifications.

_ The presence of an intermediary between the teacher and the learner is necessary, with such mediation encompassing technical, human, and organizational dimensions.
_ The learner and the teacher are not required to be present simultaneously in the same location.
_ Learners should be able to choose a learning time that suits their individual circumstances without being required to follow a predetermined schedule for meetings with instructors, except in assessment situations. (Nawal Namour, 2011, p. 28)

2.3 Comparison Between Distance Education and Traditional Education:

There are numerous differences between distance education and traditional education, primarily concerning the following aspects:

_ Distance education enables students to learn at any time, in any location, and at a pace suited to their individual needs. It is based on both individual and collaborative learning, with learners assuming considerable responsibility for their own learning. However, distance education generally deprives students of opportunities for spontaneous face-to-face interaction with their peers and teachers.
_ Given that distance education is a relatively recent educational innovation that is still undergoing development and experimentation, a number of doubts, concerns, and reservations continue to surround it. Most of these relate to its effectiveness in improving academic achievement, its relatively high economic cost, the absence of the social and human environment currently provided by traditional education, and its potential to reduce the teacher's role and opportunities for creativity. (Souad Ahmed, 2003, p. 44)
_ The introduction of distance education into educational institutions must be carefully planned through a strategic approach that considers all components of the distance education system. Such planning should not be limited to providing the necessary physical technologies, such as computers, networks, and software; rather, it should also encompass other instructional components, including educational objectives, content, learning assessment, instructional design, and management.
_ Distance education requires substantial financial investment, particularly during the initial stages of implementation, to establish the necessary computer infrastructure, train teachers and students in the

use of these technologies, and design educational content in electronic formats. By contrast, traditional education involves the costs associated with conventional instruction rather than those related to distance education and technological training, as the teacher assumes primary responsibility for transmitting knowledge to students.

- In distance education, learners have greater freedom to communicate with the teacher at any time and to ask questions about matters requiring clarification. Such communication takes place through various means, including email. In traditional education, however, communication with the teacher is generally restricted to scheduled class time, limiting students' opportunities to ask questions, particularly because class duration is often insufficient to accommodate all learners. (Tarek Abdel Raouf, 2005, p. 99)

3. Digital Platforms:

1.3. Concept of Digital Platforms:

A digital platform is a business model or digital environment developed through technology to facilitate the exchange of information and various services among different parties. It enables electronic communication, commercial transactions, and content sharing in an organized and user-friendly manner.
It is also an electronic space that facilitates interaction among multiple parties, including users, providers, and institutions. It is supported by a technological infrastructure that collects and utilizes data to deliver services, content, or transactions. Digital platforms differ from traditional websites because they rely on network effects: as the number of users increases, the value generated through their interactions also increases.

2.3. The Role of Digitalization and Its Contribution to the Development of the Higher Education and Scientific Research Sector:

The Ministry of Higher Education and Scientific Research has sought to advance higher education by placing particular emphasis on digitalization, and these efforts have produced tangible results. With regard to information and communication technologies, training in this field is now available in most Algerian universities and is also taught as a core subject at the master's and doctoral levels. In addition, universities employ specialized human resources, including engineers and technicians, responsible for managing information systems and maintaining networks. At the level of applications and platforms, the Algerian state has adopted digitalization as a strategic approach to developing higher education and scientific research. This has led to stronger information systems and the broader use of digital technologies in administration, teaching, and research. Consequently, e-learning has become an integral component of the university system, contributing to the simplification of processes related to accessing and using information.

Second: The Impact of These Transformations on Schools and Universities:

Digital transformations have brought about a profound shift within schools and universities. Education is no longer limited to the transmission of knowledge; rather, it has become a socio-technical space that reshapes the roles of both teachers and learners and raises challenges related to identity, the digital divide,

and educational quality. These transformations require the re-engineering of the learner in the context of digitalization from a sociological-educational perspective in order to understand both the pedagogical and social dimensions of change.

1. School:

- **Redefining education:** Education is no longer confined to the traditional classroom; rather, it increasingly relies on digital platforms and distance learning, thereby extending the learning environment beyond the physical boundaries of the school.
- **Changing role of the teacher:** The teacher's role has shifted from that of a transmitter of knowledge to that of a facilitator and designer of digital learning environments, with greater emphasis on developing critical-thinking skills and meaningful digital interaction.
- **New learning patterns:** New forms of learning have emerged, including network-based collaborative learning and artificial intelligence-supported self-directed learning, thereby transforming the learner's relationship with knowledge.
- **Digital socialization:** The school has become a space in which learners acquire a digital culture that, in turn, influences their identity and social relationships.

2. University:

- **The smart university:** This involves the transition from the traditional university model to the smart university model, in which technology is integrated into research, teaching, and administration.
- **Resistance to change:** Some faculty members, administrators, and students demonstrate resistance to digital transformation because of concerns about losing their status or changing established patterns of academic relationships.
- **Knowledge production:** Digitalization is reshaping the ways in which knowledge is produced and disseminated, alongside the growing prominence of e-learning and digital research.
- **Digital culture:** Universities are increasingly required to adopt institutional policies aimed at strengthening digital culture among faculty members and students.

❖ **Sociological and Pedagogical Challenges:**

- **The digital divide:** Unequal access to technology among students creates disparities in educational opportunities.
- **Educational identity:** Digital transformation raises important questions concerning the learner's identity and relationship with knowledge and society.
- **Quality of education:** It is necessary to ensure that digitalization does not lead to a decline in educational quality but instead contributes to its improvement through the use of new assessment tools.

- **Re-engineering the learner:** The learner has become the central actor in the teaching-learning process, with their role being reshaped to become an active digital participant capable of adapting to evolving digital and knowledge-based environments.

Third: The Role of Digitalization in Redefining the Relationship Between Teacher and Learner:

In the context of digitalization, the relationship between teacher and learner is no longer a traditional relationship based on one-way instruction and passive reception. Rather, it has become a dynamic relationship characterized by interaction, participation, and the redistribution of roles. From a sociological-educational perspective, this transformation can be understood through the following dimensions:

1. Dimensions of Transformation in the Relationship:

- **The teacher as a facilitator:** Digitalization has transformed the teacher from a transmitter of knowledge into a facilitator of learning who guides learners toward multiple sources and teaches them how to verify the credibility and accuracy of information.
- **The active learner:** The learner is no longer merely a recipient of knowledge but has become an active participant in its production through digital projects, collaborative research, and interactions on educational platforms.
- **Horizontal interaction:** The relationship is no longer vertical, in which the teacher teaches and the learner receives knowledge; rather, it has become more horizontal, based on dialogue, discussion, and cooperation within digital environments.
- **Continuous assessment:** Digitalization has made available tools for immediate and continuous assessment, thereby fostering a more transparent relationship between teacher and learner regarding the learner's level of progress and the skills acquired.

2. Sociological Implications:

- **Redistribution of authority:** Epistemic authority is no longer exclusively held by the teacher; rather, it has become distributed between the teacher and the learner, who now possesses the ability to access digital knowledge independently.
- **Building a digital identity:** The educational relationship has become closely linked to the formation of the learner's digital identity, as learners acquire the ability to express themselves and participate within digital spaces.
- **Social integration:** Digitalization has made the relationship between teacher and learner part of a broader social network in which both interact with a global knowledge community.

3. Pedagogical Implications:

- **Personalized learning:** The educational relationship has become more individualized, as teachers can adapt content to the needs of each learner through digital tools.
- **Collaborative learning:** Digitalization has strengthened collaborative work between students and teachers, creating a relationship based on cooperation rather than one-way instruction.

- **Immediate feedback:** Teachers can provide direct feedback through digital platforms, thereby strengthening the educational relationship and enhancing the effectiveness of the teaching-learning process.

Fourth: Educational Engineering and the Integration of Digitalization into the Educational Process:

1. Educational Engineering:

Educational engineering refers to the comprehensive redesign of the educational process so as to facilitate the transition from traditional education based on rote instruction and memorization to interactive, competency-based education. It places the learner at the center as a principal actor and redistributes roles among the teacher, the institution, and technology. It also integrates pedagogy with technology and culture, thereby transforming education into a complex social activity rather than a mere process of knowledge transmission.

2. Integrating Digitalization into the Educational Process:

The integration of digitalization refers to the incorporation of digital tools, including educational platforms, digital resources, and artificial intelligence, into the classroom. This contributes to:

- Improving learners' cognitive achievement through interactivity and multimedia resources.
- Overcoming traditional constraints such as limitations of time and place.
- Personalizing learning according to learners' abilities and interests.
- International experiences have demonstrated that digitalization enables learners to solve problems independently and develop the skills of the century.

3. Sociological and Educational Transformations:

- **The digital society:** The digital society has brought about profound transformations in the relationship between schools and society.
- **The diversification of spaces of knowledge:** The school is no longer the sole space for acquiring knowledge; rather, it is now surrounded by parallel digital spaces.
- **The erosion of educational authority:** The teacher is no longer the sole source of knowledge but increasingly occupies a more equal position alongside the learner, who now has access to digital tools.
- **The digital divide:** Technology deepens social inequalities between those who possess digital cultural capital and those who do not.
- **Book culture versus screen culture:** Schools face the challenge of preserving the values of rigorous and well-founded knowledge in the face of the fluidity and rapid circulation of digital information.

4. Comparison Between Traditional and Digital Education:

Digital Education:	**Traditional Education:**
Based on interactivity and experimentation	Based on instruction and memorization
Knowledge is distributed across digital platforms	The teacher is the sole source of knowledge

Open and flexible through the Internet	Restricted by time and place
Promotes creativity and greater technological equality	Reinforces discipline and hierarchy
Capable of adapting to rapid transformations	Faces difficulties in keeping pace with change

Fifth: The Socio-Educational Approach: Studying Social Interactions Within the Digital Educational Space:

The socio-educational approach to studying the digital educational space is based on the premise that education is not merely a cognitive process, but rather a network of social interactions that are being reshaped by digitalization.

1. The Digital Space as a Social Space:

• The digital educational space is no longer merely a technological medium; it has become a social space in which new relationships are formed among learners, teachers, and institutions.

• It enables learners to construct digital identities and interact with their peers through educational platforms, thereby strengthening their sense of belonging to a global knowledge community.

• It creates new dynamics, such as virtual collaboration and network-based collaborative learning.

2. Social Interactions Within Digital Education:

- **Interaction among learners:** Interaction shifts from a competitive relationship toward a participatory one, in which learners exchange digital resources and develop collaborative projects.
- **The role of the teacher:** The teacher is no longer an absolute epistemic authority but has become a guide and facilitator of learning who accompanies learners in constructing their individual learning pathways.
- **Pedagogical relationships:** These relationships are shifting from vertical structures (teacher–learner) toward horizontal structures (learning networks and digital communities).

3. Comparison Between Traditional and Digital Interactions:

Digital Interactions:	**Traditional Interactions:**
Extend across digital platforms	Occur only within the classroom
Authority is distributed among the teacher, the learner, and the network	The learner is the source of authority
Open and transnational relationships	Relationships restricted by time and place
Broad and collaborative participation	Limited participation
The learner's identity is dynamic and multiple	The learner's identity is fixed

4. Key Challenges of the Socio-Educational Approach:

- The need to reformulate pedagogical practices so that they are compatible with digital interactions.

- Addressing the digital divide, which may generate forms of social exclusion.
- Promoting the values of digital citizenship and ethical responsibility in the use of technology.
- Building digital learning communities capable of producing knowledge rather than merely consuming it.

Sixth: Pedagogical Transformations:

1. The Emergence of the Student as a Key Actor in Knowledge Construction:

Digital transformations have led to a reconsideration of the student's position within the educational process. The student is no longer viewed as a passive recipient of knowledge transmitted by the teacher but has become an active participant in the production and construction of knowledge. This transformation is grounded in contemporary pedagogical perspectives that regard learning as an active process in which learners construct their own knowledge through interaction with their environment, their peers, and the various educational resources available to them.

The digital environment has contributed to strengthening this role by providing multiple sources of knowledge and creating greater opportunities for research, exploration, and self-directed learning. Students are now able to access information, analyze and compare it, and employ it in constructing new knowledge rather than merely receiving it. Digital tools have also facilitated the emergence of new learning patterns based on participation, collaboration, and project completion, thereby strengthening learners' autonomy and their capacity to assume responsibility for their own learning.

From a sociological-educational perspective, this transformation reflects a change in the nature of the relationship among the different actors involved in the educational process. Knowledge is no longer a form of authority monopolized exclusively by the teacher; rather, it has become a domain of interaction and exchange among the various educational actors. Consequently, the teacher's role has shifted from that of a transmitter of knowledge to that of a guide and facilitator of the learning process, while the student has become a partner in knowledge production and assumes a more active role in shaping their own learning pathway.

Accordingly, the emergence of the student as a key actor in knowledge construction represents one of the most significant pedagogical transformations generated by digitalization. The objective of the educational process is no longer limited to the acquisition of information but increasingly encompasses the development of learners' capacities for inquiry, reflection, critical thinking, and knowledge production.

2. Redefining the Role of the "Teacher": From Knowledge Transmitter to Facilitator:

The transformation of the teacher's role constitutes one of the most significant manifestations of the transition toward learner engineering as an educational approach that responds to contemporary social and epistemological transformations. Whereas traditional pedagogy regards the teacher as the primary source of knowledge and reduces their role to transmitting and imparting information, contemporary pedagogical approaches have reconstructed this role in accordance with the philosophy of active learning, which places the learner at the center of the educational process.

Within this framework, the teacher is no longer the sole holder of knowledge but has become a guide and facilitator of learning processes. The teacher designs learning situations that enable learners to engage in inquiry and discovery and to draw on their prior knowledge in constructing new knowledge. The teacher also seeks to stimulate classroom dialogue, encourage critical thinking, and foster initiative and cooperation, while taking into account individual differences among learners in ways that contribute to meaningful and sustainable learning.

From a sociological perspective, this transformation reflects a change in the nature of educational authority within educational institutions. The relationship between teacher and learner is no longer vertical and based on epistemic dominance; rather, it has become relatively horizontal, grounded in interaction, participation, and negotiation around knowledge. This strengthens learners' integration into the classroom community, develops their sense of responsibility and autonomy, and prepares them to participate in a knowledge society that requires competence and the capacity for continuous learning rather than the mere possession of information.

This transformation can also be understood in light of Pierre Bourdieu's analysis, which emphasizes that the school is not merely a neutral space for transmitting knowledge but a social institution shaped by power relations and patterns of cultural capital distribution. Digital transformation is reshaping these relations by redistributing sources of knowledge, thereby requiring teachers to shift from an authority based on the possession of information toward a form of professional authority grounded in their capacity to provide structure, guidance, and meaningful learning experiences.

This perspective draws on a range of theoretical foundations. John Dewey emphasizes that genuine learning is achieved through experience and practice. Jean Piaget argues that learners construct their own knowledge through interaction with their environment, while Lev Vygotsky highlights the importance of social interaction in knowledge construction and assigns the teacher the role of a "mediator" who provides support and guidance within the zone of proximal development, thereby enabling learners to progress toward greater autonomy in learning.

Accordingly, redefining the teacher's role in the context of digitalization represents a transformation of the pedagogical model itself. The educational relationship shifts from a vertical model based on one-way instruction toward a participatory model founded on dialogue, interaction, and the collaborative construction of knowledge. The teacher thus becomes a key actor in learner engineering, not as a transmitter of information but as a guide and facilitator capable of developing an autonomous and critical learner who can integrate effectively into the knowledge society and adapt to rapidly evolving digital transformations.

3. The Impact of Digitalization on Learners' Educational and Cultural Identity:

The impact of digitalization on learners' educational and cultural identity cannot be examined independently of the social conditions framing this transformation, because technology does not operate within a social vacuum; rather, it interacts with existing economic and cultural structures. From this perspective, a fundamental question arises concerning the extent to which digitalization can promote

equality of educational opportunity or, conversely, contribute to reproducing new forms of inequality among learners.

Although digitalization has opened broad horizons for learners to access knowledge and extend learning spaces beyond the boundaries of the school, the extent to which these opportunities can be utilized remains dependent on several factors, including the availability of digital equipment, Internet access, and the level of digital competence possessed by learners and their families. Consequently, learners do not enter the digital environment from identical social positions; rather, they bring with them inequalities associated with economic, cultural, and social capital, which can sometimes transform technology into an instrument that reinforces disparities rather than overcoming them.

Within the framework of the sociological-educational approach, the impact of digitalization is not limited to changing learning tools; it also extends to reshaping learners' educational and cultural identities. Learners have become active participants in the production and exchange of knowledge through digital environments after previously occupying the position of recipients within the traditional school setting. This transformation reflects a shift from an educational model based on one-way instruction toward a model centered on autonomy, interaction, and self-directed learning.

At the same time, digitalization has generated new challenges, most notably the influence of global digital content on learners' cultural frames of reference, alongside the emergence of a digital divide resulting from unequal opportunities to access technology and acquire digital competencies. From this perspective, Pierre Bourdieu argues that inequalities in the possession of cultural capital may contribute to the reproduction of inequality within schools. This analysis can also be applied to the digital environment, where digital competencies have come to represent a new form of cultural capital.

Manuel Castells also demonstrates that identity in the network society has become more open and plural, as it is shaped through continuous interaction within digital spaces. Accordingly, the role of the school is no longer limited to transmitting knowledge; it is increasingly required to develop critical thinking, promote digital citizenship, and establish a balance between openness to global culture and the preservation of local cultural identity.

Therefore, learner engineering in the context of digitalization requires the development of learners who possess the digital and critical competencies necessary to benefit from digital transformation while preserving their educational and cultural identity, thereby ensuring their positive integration into the knowledge society.

Seventh: Challenges:

1. Resistance to Change Among Educational Actors:

Resistance to change represents one of the central issues in explaining the slow pace of pedagogical transformations associated with digitalization. From a sociological-educational perspective, such resistance does not necessarily stem from a rejection of technology itself, but rather from the changes it imposes on professional roles, pedagogical relationships, and the organizational culture of educational institutions. The transition from a pedagogy based on knowledge transmission to one centered on active

learning redistributes authority within the classroom, placing the learner at the center of the educational process while redefining the teacher's role as a guide and facilitator of learning.

Pierre Bourdieu argues that professional practices are shaped by a system of deeply rooted habits and representations, making the acceptance of change a complex process, particularly when digitalization is perceived as threatening traditional teaching practices or diminishing the teacher's status as the primary source of knowledge. Michael Fullan likewise emphasizes that the success of educational reforms depends more on transforming the professional culture of educational actors than on the mere introduction of technological tools.

Accordingly, overcoming resistance to change requires the adoption of a participatory approach based on continuous training, pedagogical support, and the active involvement of educational actors in digital transformation projects. Learner engineering in the context of digitalization can only be achieved within a broader cultural and institutional transformation that reconstructs the roles of all educational actors and enables them to become partners in creating a learning environment that is more flexible, innovative, and responsive to the requirements of the knowledge society.

2. The Challenge of Assessment and Quality Assurance in Digital Education:

Assessment and quality assurance are among the most significant challenges facing learner engineering in the context of digitalization, as traditional assessment methods are no longer sufficient to measure the competencies required in digital learning environments, such as critical thinking, self-directed learning, collaboration, and problem-solving. From a sociological-educational perspective, digital transformation is not limited to changing assessment tools; rather, it reshapes the very concept of assessment and its functions within educational environments.

Digital environments have generated several issues related to assessment credibility, equal opportunities among learners, and the prevention of academic dishonesty, in addition to inequalities in digital competencies, all of which may affect the fairness of assessment and the quality of learning outcomes. The increasing reliance on digital platforms and artificial intelligence also requires a reconsideration of quality standards so that they are not limited to measuring cognitive achievement but also encompass the quality of interaction, the effectiveness of learning, and the extent to which targeted competencies are achieved.

Philippe Perrenoud emphasizes that assessment should function as a means of accompanying and supporting learning rather than merely as an instrument for judging its outcomes. Michael Fullan, meanwhile, argues that successful digital transformation requires the development of an institutional culture of quality based on continuous improvement, the professional development of educational actors, and the adoption of clear standards for digital assessment.

Accordingly, learner engineering in the digital age requires the development of flexible and equitable assessment systems that combine formative and summative assessment and make effective use of digital tools in ways that ensure the quality of learning, uphold the principle of equal opportunity, and strengthen societal confidence in the outcomes of digital education.

3. Risks of Social Isolation or the Loss of the Human Dimension in Education:

Despite the opportunities provided by digitalization to broaden access to knowledge and develop learning methods, it also raises sociological and educational challenges, among the most significant of which are the growing risks of social isolation and the erosion of the human dimension in the educational process. Direct interaction between the teacher and the learner, as well as among learners themselves, is not limited to the exchange of knowledge; rather, it constitutes an important space for fostering values, developing communication skills, and strengthening a sense of belonging to the school community.

From a sociological-educational perspective, excessive reliance on digital learning may weaken social relationships within educational institutions, particularly when virtual communication replaces face-to-face interaction. This may negatively affect the development of learners' social and emotional skills, such as dialogue, cooperation, and empathy, which are essential competencies that are no less important than cognitive competencies.

Émile Durkheim maintains that the school performs a social function by socializing individuals into shared values and promoting social integration, a function that may be weakened if education is reduced to its technological dimension. Edgar Morin likewise emphasizes that education should preserve its human dimension by fostering relationships, communication, and mutual understanding alongside the acquisition of knowledge.

Therefore, learner engineering in the context of digitalization requires achieving a balance between benefiting from the opportunities offered by technology and preserving the human dimension of education. This can be achieved through the adoption of participatory pedagogies, the encouragement of collaborative work, and the promotion of both direct and digital interaction. The success of digital transformation should not be measured solely by the extent to which technology is employed, but also by its capacity to develop learners who are cognitively competent, socially engaged, and capable of integrating positively into society.

Conclusion:

This study concludes that digitalization represents a structural transformation within the educational system that extends beyond the mere use of technology to encompass the philosophy of education, the roles of educational actors, patterns of interaction, and the production of knowledge. It has demonstrated that artificial intelligence, distance education, and digital platforms have contributed to reshaping learning environments and generating a new conception of learner engineering based on the development of digital competencies, autonomy, and lifelong learning.

The sociological-educational approach has also demonstrated that pedagogical transformations cannot be understood independently of the social and cultural dimensions that shape educational practice. Consequently, the successful integration of digitalization depends on the effective alignment of technological, educational, and social dimensions. Within this context, educational engineering emerges as a strategic approach to redesigning the educational process in ways that are consistent with the requirements of the digital environment.

Despite the opportunities that digitalization provides for improving educational quality and expanding learning opportunities, it also presents challenges related to narrowing the digital divide, developing human resources, and strengthening ethical standards governing the use of modern technologies. Therefore, developing learners capable of interacting positively with the changing realities of the digital age requires the adoption of a comprehensive educational vision grounded in the integration of technology and pedagogy, thereby contributing to the development of an educational system that is of higher quality, greater effectiveness, and enhanced sustainability.

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