

AI In the Service of Education: Building a New Education Ecosystem Based On the International Approaches

BENABID Bilal^{*1}, IKLAFEN Sanae^{2,*} EL OUADI Abdelmajid³, CHBANI SADKI NOURA

¹ LISA “Systems and advanced Technologies Laboratory”, Ibn Tofail University, Kenitra, Morocco

² “Larmodad Laboratory”, FSJES Souissi University, Rabat, Morocco

³ LISA “Systems and advanced Technologies Laboratory”, Ibn Tofail University, Kenitra, Morocco

Abstract

In the era of big data, robotics and automation, learning approaches diversity is becoming increasingly important and the education system must evolve and take into account the new emerging needs.

The field of education represents major and even crucial challenges in the development of societies. Today, there is a strong need to review the education system and the teaching techniques at the global level and rethink it in the light of technological and scientific progress that the world is experiencing in order to remedy existing problems and imperfections with today’s solutions.

Human knowledge, computerized, represented by artificial intelligence, can indeed help to solve problems related to education and to make it evolve by taking advantage of the different opportunities in the sector. Many learning methodologies could be improved thanks to artificial intelligence tools and algorithmic concept. Among these technologies are NLP, computer vision, and other smart tools, both collaborative and interactive.

On the basis of a comparative study -taking France’s local system as a case study- on the different practices carried out by world pioneers to make the AI in the service of education, this work answers to the following questions:

- What are the main imperfections in the centuries-old classical education system?
- What impacts could AI have on this system to improve its profitability? Which methods are used by the AI leaders countries?
- What are the main efforts made to improve the French educational system through AI tools applied to learning and teaching methodologies?

Keywords: Artificial intelligence, Teaching, Personalized learning, Machine learning, Concept mapping

1. Introduction

The digital revolution, having taken place in the twentieth century, opened the way to new disciplines aiming not only to feed the machine with data, but also to program it in such a way that it reproduces a “reasoning” and smart answers by computer tools.

The idea behind this reflection is to make the machine intelligent, having the necessary cognitive abilities to think, recognize, analyze and adapt to situations of different complexity, as a human being would, and therefore, develop an output of intelligence comparable to that of humans, even more efficient and independent of external factors such as emotions and physical state.

This “discovery”, having taken time before gaining legitimacy and recognition in the ranks of scientists, continues to develop in all directions. Today, the scientific community has not only succeeded in applying it - or at least initiate its application - in almost all sectors, but has also succeeded in developing it to give birth to other IT branches such as “machine learning” and “Natural language processing”, in a logic that promotes big data analysis and pushes the statistical challenges to the next level. From discovery to experimentation, artificial intelligence has seen very satisfactory results in sectors such as health, industry, finance and energy, while others are showing fairly promising results, as in the case of the economic sector, logistics and transport.

Many experiments have shown that the machine - endowed with artificial intelligence - is not only capable of carrying out “human” tasks of a complex order, but also showed that its performance can be significantly superior to that of the human rights at specific levels, which remarkably sparked a sort of “secret war”, a race, led by governments - supported by the private sector and civil societies - to seize power over the use of AI and make it an economic and political power in the near future.

This relentlessness is reflected mainly in studies and multisectoral strategies carried out, for several years, by the great world powers such as China and the United States, and in the budgets invested in the research and development of AI solutions in several sectors. Indeed, this political ambition is not limited to the areas mentioned above but also extends to other sectors, as evolving as they are strategic, such as education where the issues and areas for improvement are huge, with relatively critical issues. As a result, questions are multiplying and the debate continues to arouse public interest.

- What are the main weaknesses observed in the “current” classical education system established for centuries?
- What impacts could AI have on this system in order to improve its profitability? What methods to use?
- How to adapt the proposed solutions according to the learner's references and background?

These questions turn out to be even more interesting in the case of the French model, where human and technological resources are available, without the results meeting expectations, compared to other models, in the English-speaking sphere in particular.

Hence the interest in pointing out the opportunities presented by openness to the different approaches put in place in order to make AI at the service of education, and thus "boost" the

French economy and its social structure. It is with this in mind, and with a participatory approach, that this scientific article is written.

This work aims to understand the impact that AI may have on the education system (and ecosystem) in France and the appropriate way to promote innovation, experimentation and the implementation of software solutions, AI based, with the aim of solving problems related to the field of education, at a lower cost, while preparing a well-trained generation aligned with the technological progress of the most developed countries in the world. This, on the basis of several studies carried out internationally, by governmental and private institutions, with an inclusive, globalist and innovative logic.

The first section deals with AI, presenting itself as a topical discipline, having proven its usefulness in several sectors of activity, and therefore an opportunity, potentially grasped by decision-makers in the educational environment.

The second section presents the functioning of the classical teaching model by focusing on its main flaws and shortcomings.

The third, and following a comparative and analytical approach, will present the main lines of application of AI for the benefit of education as well as the strategies adopted by the great leaders of AI around the world.

2. The contribution of AI in education

Artificial intelligence is developing at an exponential rate, putting human life in perpetual questioning, by transforming its environment and all of its daily habits.

Being considered in the current context as a revealing element of the scientific and technological progress of countries, and although requiring considerable research resources, more and more countries are beginning to invest in artificial intelligence by establishing specialized research structures, while opening the door to experiments and any initiative promoting their use for the common interest. Indeed, the challenges and opportunities presented by AI are likely to revolutionize macroeconomic and societal models as well as foreign policies. Hence the use of the term "4th industrial revolution" to qualify today's industry, based among other things on digitization, connected objects and artificial intelligence.

Thus, it is necessary to understand and to break down the logic which makes that AI is solicited for uses as numerous as critical. There are many reasoning methods and algorithms that can be used to solve AI problems, but they all rely on the same parameters.

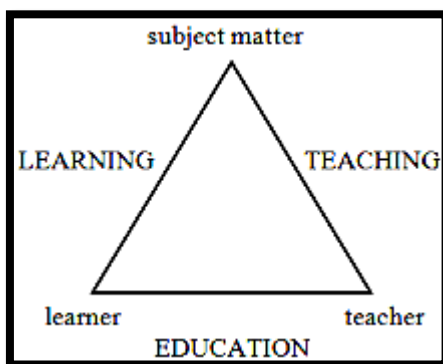
3. Classical teaching model: Inheritance and failures

3.1 Inheritance: a frozen structure

The current teaching model, which has existed for several centuries - in universities as well as in primary and secondary establishments - almost unchangeable at the structural and

pedagogical level, can be reduced to well-defined actors and often bilateral interactions between its different entities according to a fairly rigid didactic triangle.

Figure 1 - The classic didactic triangle



The didactic triangle, proposed in the diagram above, which we borrow from Houssaye (1988) for illustration, results in complementary actors and processes, but not flexible enough to open up to interveners other than the teacher and the learner, or on other supports and other processes - educational and cognitive - potentially beneficial to strengthen learning and the effectiveness of the education system.

3.2 The failures of the current system

The traditional teaching model, inherited for generations and adopted around the world, remains faulty on several levels; for so long, individual initiatives, translated into the private sector, have aimed to enrich this system with other educational and logistical devices in order to support the technological revolution of our time and to put technology at the service of the teaching, in a logic of analysis and resolution.

As a result, several signs of defect are observed and singled out in the current system:

- Absenteeism and dropping out of school,
- Poor assessment of skills,
- Educational content not adapted to the needs of the economic market,
- System limiting the creative capacities of the learner and the apprentice at the same time.

4. From problem to solution

4.1 Areas for improvement

These issues can be categorized and included in areas for improvement, as follows:

- Access to knowledge
- The educational offer
- Skills simulation and development

4.2 Reference models: State of the art and methodology

In developing this work, a comparative approach was applied to measure the different perspectives offered by the field of artificial intelligence in the education sector, making it possible to resolve common issues of the classical education model.

4.3 Benchmarking - Methodology

A list of reference countries was taken as the research perimeter, on the basis of the following factors:

- (C1): Progress made in the field of AI
- (C2): Innovation and openness to technological developments
- (C3): Quality and efficiency of teaching
- (C4): Reconciliation with the French economic model
- (C5): Geopolitical proximity
- (C6): Documentation

On an initial sample* of 10 countries, a benchmark was carried out on the basis of the criteria mentioned, in order to select a reduced list of 4 countries serving as study subject.

Figure 2 - Benchmark on international models

Country/ Criteria	C1	C2	C3	C4	C5	C6	Final score
US	5	4	3	2	4	4	44
China	5	3	5	0	2	2	31
UK	4	4	4	2	2	1	32
Canada	4	3	5	2	3	2	36
Finland	0	5	5	2	1	3	24
UAE	0	3	2	2	4	1	21
Spain	1	2	3	3	1	2	23
Russia	1	2	2	1	3	1	18
Japan	2	4	5	0	2	1	21
Germany	1	3	4	3	1	2	23

(*): Countries: United States, China, United Kingdom, Canada, Finland, UAE, Spain, Russia, Japan, Germany.

For a better understanding of the situation, and by logic of priority and feasibility, a coefficient system was applied to the selection criteria.

Thus, on these bases and the obtained scores, and in a logic of diversification, the following countries were retained as a reference for the rest of this work: United States, China, Canada, United Kingdom.

4.4 Approaches and initiatives

The in-depth study carried out highlighted a set of ideas observed since the results observed internationally:

- The use of AI in the education sector remains recent and is less than ten years old,
- Only the United States has taken the lead by making the private sector, independently, a real engine of investment in this area,
- China, with the dynamism of its specialized startups, the variety of initiatives put in place and the political involvement of its regime, will, in less than ten years, be at the world summit in terms of AI exploitation in education.
- France, thanks to government initiatives launched since 2017, then supported by the private sector, is a European force of the future, but is still far from global competition, in terms of investments, experiments and achievements.
- The classical teaching model constitutes, by its fixed structure, a real obstacle to the implementation of AI with the various changes that it promises and represents.

4.5 Case study: The French model

The study put in place highlighted several initiatives aimed at developing the French education system towards a more digital and AI-adapted era. (Mahjoubi, 2018)

Thus, we can conclude that this subject is today a national priority and a key step in a state strategy, aimed at improving economic competitiveness on the basis of technological investments.

4.5.1 A state strategy:

In 2017, the French government clearly expressed its ambition to establish the country as a “leader in artificial intelligence”, at European and global level, with the objective of competing with countries such as China and the United States, considered until then as masters of AI in the world; this, by bringing together the many emerging initiatives of the French private sector and by defining a concerted national strategy leading to a more solid AI community with the necessary means to support the French economy.

Initiated by the Ministry of Higher Education, a national AI research strategy was put in place, where, over the course of several months, 17 working groups met to propose public policy actions aimed at developing the artificial intelligence in France and to facilitate the appropriation of technologies by the economic fabric.

At the end of this public discussion, around fifty proposals were raised by the various working groups, most of which were implemented in 2018 itself. Among others:

- Establishment of the France AI strategic committee bringing together the academic, scientific, economic and civil society spheres, responsible for implementing the recommendations of the working groups

- Launch of a new program mobilizing research institutions to identify, attract and retain the best talents in AI.
- Funding of a shared infrastructure for research
- Constitution of a public-private consortium with a view to identifying or creating an interdisciplinary center for artificial intelligence
- Systematic inclusion, in 2017, of A.I. in the priorities of all public innovation support mechanisms
- Launch of a call for projects for sectoral data sharing platforms for 3 to 6 sectors, at the end of 2017

In addition, the deputy Cédric Villani was mandated to produce a report and strategic recommendations in the field, to make AI the engine of the French economy of the future by focusing government efforts on the most priority sectors, likely to crystallize the interest and continued involvement of stakeholders. (Villani, 2018)

This report produced in 2018, inspired by long reflections, came naturally to follow another, the “France IA” report, initiated by Axelle Lemaire, a year earlier, at the launch of the national AI strategy, as well as the report of the Parliamentary Office for the Evaluation of Scientific and Technological Choices (OPECST) for 2016, going in the same direction.

4.5.2 Recommendations and practical measures: Results

Resulting from studies conducted by the state, recommendations - considered new to the current teaching model - were communicated for implementation, mainly, in the report by Cédric Villani; some of which have already been created through practical and concrete initiatives. In general, and in relation to the areas for improvement discussed in the chapter “Current teaching model”, the following solutions, mainly AI-based, have been proposed:

- Develop understanding of the interest in studies via AI tools:
- Reinforce student motivation and engagement through gamification and AI (AI-based software / simulators). (Kiely, 2005)
- Strengthen intelligent mobile learning for the most difficult to reach: (implement intelligent tutor systems in distance learning platforms)
- Serve other sectors by putting education at the service of AI [cross-curricular programs, applied AI research theses ...]
- Encourage collaborative learning, AI based (Example: "chatbot" software) and collective intelligence in classrooms to make students more successful. (Shi et al., 2002)
- Provide machine assistance to teachers: Virtual assistants, eg Diva.
- Adopt a personalized and adaptive teaching (personalized training, according to the need, the social environment, the pace of learning, the interest, the ambitions and the aptitudes of the individual) which takes into account the diversity of the rhythms of learning and cognitive styles of students. (Chen, 2008)
- Facilitate the use (collection, mapping, analysis, etc.) of learning data under the control of the learner / and or his pedagogical manager (s), and experiment in real time the learning trajectories.

- Develop "empowering" complementarity with AI, more creative teaching to better understand and communicate with machines: Provide everyone with a general knowledge of AI and algorithms.

Other more strategic recommendations were included in this report:

- Increase the number of experiments by evaluating their effects on the educational process.
- Leading a watch / prospective reflection on AI and its challenges within the university.
- Encourage / support companies (EdTech), aiming to produce tools for education, especially AI based, in collaboration with teachers and educational managers, for a better understanding of the need
- Attract international talent in AI: research students
- Foster the working conditions of laboratories and research institutes, in terms of funding, networking, etc.

And as this is a topical public exchange, and a multisectoral dynamic, our research also focused on other recommendations expressed on different occasions, developed by other components of civil society in France, in particular computer scientists and specialists in the field of teaching and education:

- Offer alternative learning solutions in parallel: Robots available to ask questions and ask for explanations repeatedly: The objective is to overcome the psychic fears of the learner.
- Offer talking and communicating books to reinforce language skills through scheduled conversations. (Pikhart, 2020) (Vandewaetere & Clarebout, 2014)
- Help teachers to better master digital technologies related to AI (learning to learn)

5. The New Education System in the era of AI

This state-of-the-art work, having focused on the political dimension of AI in the future strategies of countries, the subject of our study, and the place granted to education through the various actions implemented during the years, has allowed us to see that with the exception of the United States, which has been years ahead through a multitude of solutions offered by local startups, since 2012, so early tested by several establishments in the country, usage remains recent in the rest of the world.

In the rest of the world, it was generally only from 2017 that AI began to be perceived as a discipline that could revolutionize critical sectors of countries, inevitably including education and higher education.

The different action plans of the countries all converge on a massive budgetary investment to strengthen its use in the educational environment through experiments and continuous exchanges.

The national strategies put in place, as well as individual and entrepreneurial initiatives, show a tendency towards the invention of new learning systems, making the learner in the center of

this equation, starting from a better understanding of his abilities (physical and intellectual), his environment, his appetites and his psychological references, to offer adapted software solutions, also serving the teacher for a better understanding of the need and progress of the assimilation of the concepts taught, in order to point, more easily, areas for improvement via personalized and more efficient methodologies.

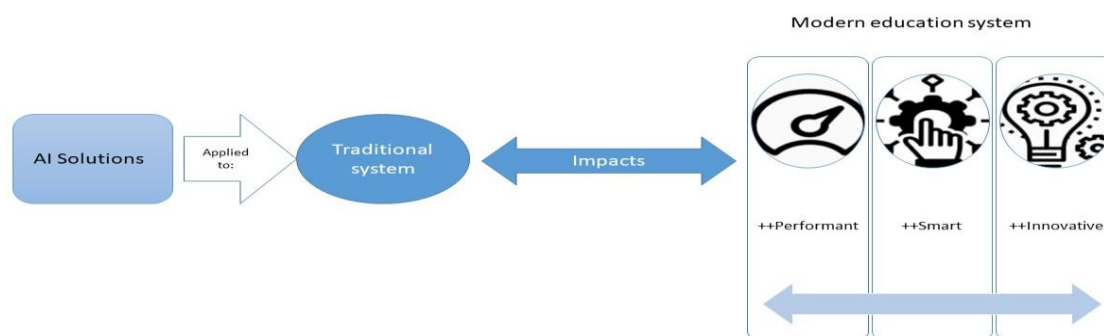
These recommendations, mentioned in our study, also go in the direction of democratizing knowledge by making it accessible to all and by encouraging the learning of AI, and therefore, to ensure that AI facilitates the acquisition of knowledge, via advanced technological methods and tools, but also to allow AI to benefit the educational sphere, to develop its use in other sectors and bring added value to the economy.

Again, it would be possible to say that the global race to use AI in education is a race that has only just started, and that the different experiences implemented (adoption of personalized learning, introduction of robot assistants, etc.) are likely to be propagated and reused, in a context of globalization which facilitates access to this type of initiative thanks to the various cooperation and information sharing mechanisms.

This context means that a new education system, modern and universal, is being implemented, based on AI, with characteristics different from the existing one and wider applications, extended to all sectors.

By a mathematical analogy, as expressed in the diagram below, this metamorphosis can be compared to a “convolution” product, involving an input signal on an existing system (current teaching system), to give rise to “A response”, corresponding to this new modern AI-based system.

Figure 3 – Illustration of the modern education system in the age of AI



The AI tools combined with the current system could lead to a new system more performant, based on innovation, adaptability and sharing.

6. Discussion:

During the development of this work, we were forced into several difficulties, mainly the lack of documentation and academic AI contacts in France. This work was also characterized by an important theoretical layer; exact statistics - on the use of AI in educational establishments - are non-existent in the various references consulted as this is a relatively recent field of experimentation, not formalized, where the detailed results of studies carried out, will only be expected in the few coming years.

For the rest of our research, we plan to extend the experience to the University of Angers, and its various establishments, as well as some schools in the city. The objective, initially, being to reinforce the analysis and the detection of the failures noted by the learner and the teacher, before proceeding to an experimental program, on the basis of AI software tools, which, after set up on a study sample, should provide information on the feasibility and contributions of this technology, at university and at school.

Concretely, the experience would be to measure the progress of students, using AI based tools for educational purpose, in their studies. This would be especially applied on students of Linguistic branches, but also mathematics to exploit the diversity of software tools provided by the opensource international market. Then, in a second time, the goal would be to extend the experience to new categories of students, and especially the younger ones and the disabled persons.

7. Conclusion

Artificial intelligence continues to gain momentum on a global scale by extending its scope of application to various issues of high economic and social criticality.

Efforts have been established by decision-makers in the most advanced countries, since 2012, to put in place strategic plans aimed at identifying the use of AI in the various sectors, and thus, gaining points in the economic race, while ensuring the necessary resources.

Among the most promising sectors benefiting from this technological progress is the education sector, which also has the distinction of being a driving force behind the development and strengthening of AI, in both aspects: theoretical and applied.

This work takes up the approaches adopted by a few reference countries, aiming to benefit from artificial intelligence to transform the teaching model by making it more suited to technological progress, as well as the various initiatives put in place by governments and civil society to support this dynamic of experimentation and reflection.

This work aims to make the experiences of these countries a reference ground for benefiting, in the era of globalization, from their experiences in terms of methods and results.

Researchers in the field of education, entrepreneurs, the various players in the educational sphere can also find a middle way to promote access to knowledge, and improve the quality of education in France, with lower costs, and using potentially accessible means.

References

- Chen, C.-M. (2008). Intelligent web-based learning system with personalized learning path guidance. *Computers & Education*, 51(2), 787- 814. <https://doi.org/10.1016/j.compedu.2007.08.004>
- Kiely, R. (2005). A Transformative Learning Model for Service-Learning: A Longitudinal Case Study. *Michigan Journal of Community Service Learning*, 12(1), 5- 22.
- Pikhart, M. (2020). Intelligent information processing for language education: The use of artificial intelligence in language learning apps. *Procedia Computer Science*, 176, 1412- 1419. <https://doi.org/10.1016/j.procs.2020.09.151>
- Shell, D. F., Brooks, D. W., Trainin, G., Wilson, K. M., Kauffman, D. F., & Herr, L. M. (2010). The Unified Learning Model. In D. F. Shell, D. W. Brooks, G. Trainin, K. M. Wilson, D. F. Kauffman, & L. M. Herr (Éds.), *The Unified Learning Model: How Motivational, Cognitive, and Neurobiological Sciences Inform Best Teaching Practices* (p. 1- 4). Springer Netherlands. https://doi.org/10.1007/978-90-481-3215-7_1
- Shi, H., Revithis, S., & Chen, S.-S. (2002). An agent enabling personalized learning in e-learning environments. *Proceedings of the first international joint conference on Autonomous agents and multiagent systems: part 2*, 847–848. <https://doi.org/10.1145/544862.544941>
- Vandewaetere, M., & Clarebout, G. (2014). Advanced Technologies for Personalized Learning, Instruction, and Performance. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Éds.), *Handbook of Research on Educational Communications and Technology* (p. 425- 437). Springer. https://doi.org/10.1007/978-1-4614-3185-5_34
- Mounir Mahjoubi, 2018. *Government report*. Ministry of higher education, France.
- Oded Meyer & Candace Thille, 2008. “*The Open Learning Initiative: Measuring the effectiveness of the OLI statistics course in accelerating student learning*”. Journal of Interactive Media in Education, USA.
- Laurent Alexandre, 2017. « *La guerre des intelligences* ». Lattes, France.
- Cédric Villani, 2018. « *Donner un sens à l’intelligence artificielle* », Aiforhumanity, France.