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Challenges of AI in Education: analysis of UNESCO reports 2019-2021

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Résumé : Les rapports de l'UNESCO analysent les défis introduits par l'intelligence artificielle dans l'éducation. Cette revue de la littérature présente les enjeux pour les États et l'évolution de ses recommandations. Une méthodologie en deux étapes avec d'abord la construction d'une grille d'analyse des rapports. Ensuite, nous déterminerons les évolutions des recommandations sur la base d'un traitement textométrique des synthèses des rapports.

Abstract: UNESCO's reports analyze the challenges introduced by artificial intelligence in education. This literature review presents challenges for states and the evolution of its recommendations. A two-step methodology is proposed with first the construction of a grid to analyze the reports. Then, we will determine the evolutions of the recommendations and the observable themes in education, based on a textometric processing of the summaries of the reports.

Mots clés : intelligence artificielle en éducation (IAEd), enjeux, UNESCO.

Keywords: artificial intelligence in education (AIE), challenges, UNESCO.

1. INTRODUCTION

Our studies present a literature review of UNESCO reports from 2019 to 2021 on artificial intelligence and education.

Two techniques have been developed to realize literature review: systematic reviews and non-systematic reviews (Hoarau et al., 2021). As our review will focus on five UNESCO reports, we have selected (Roth, s. d.) the narrative literature review method (Cornell University Library, 2019).

First, a presentation of our object through the introduction of artificial intelligence in education. Secondly, the methodology used to collect the sources for the narrative literature review of UNESCO reports between 2019 and 2021, followed by our methodology analysis. In a fifth step, we will interpret the results obtained. Finally, we will conclude the review and present some perspectives.

1.1 Introduction to Artificial Intelligence (AI)

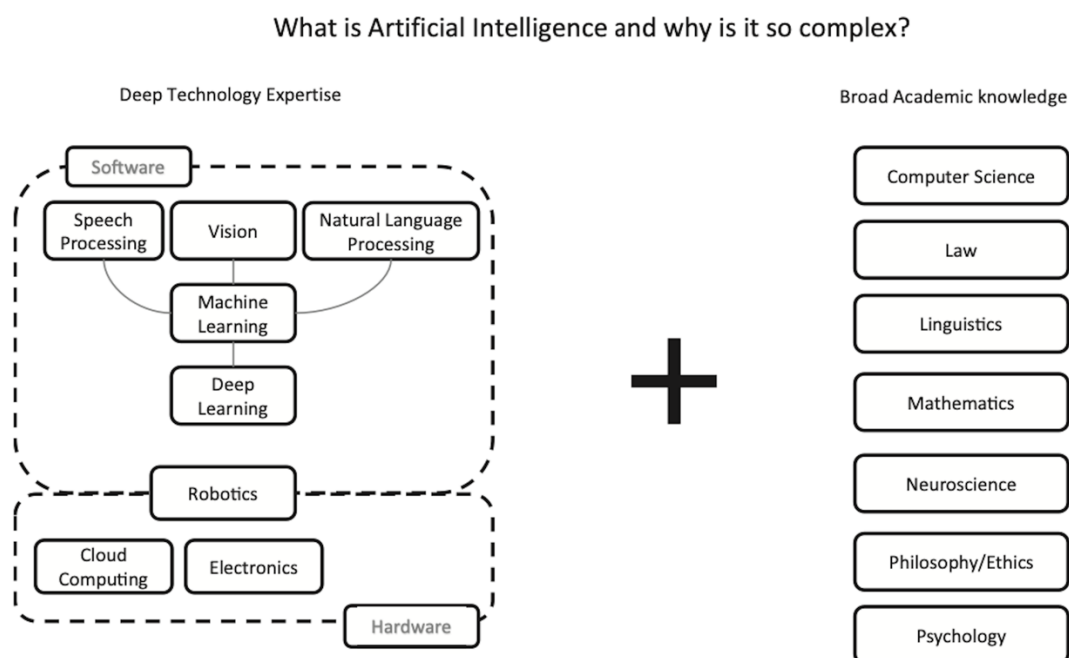
Artificial intelligence became a scientific discipline at the end of the Dartmouth conference in 1956. The term "AI" was introduced by John McCarthy and Marvin Lee Minsky (Dick, 2019). Even today, the definition of AI is not well defined. However, Yann Le Cun (Le Cun, 2019)

defines it as: artificial intelligence (AI) is a set of techniques allowing machines to perform tasks and solve problems normally reserved for humans and certain animals. Artificial intelligence is characterized by techniques (including machine learning and deep learning) carried by algorithms (figure 1) and technologies (for example: conversational agents, computer vision) and it involves different scientific disciplines (figure 2).

Table 3. Examples of the popular adopted techniques of DL, ML, and AI.

Techniques	Examples of algorithms
DL	artificial neural networks, deep belief networks, deep neural networks, recurrent neural networks, convolutional neural networks, long short-term memory, generative adversarial networks, variational auto-encoders, adversarial learning, convolutional neural networks
ML	reinforcement learning, decision trees, support vector machines, regression analysis, Bayesian networks, genetic algorithms
AI	fuzzy logic, rule-based systems, agent system, heuristic algorithms

Figure 1 Examples of popular adopted techniques of DL, ML, and AI. (Chen, Xie, Zou, et al., 2020)



Map of AI disciplines.

Figure 2 What is artificial intelligence and why is it so complex? (Campbell, 2022)

Thus, artificial intelligence is a combination of decision algorithms and large numbers of data (Gupta & Pal, 2021). To date, there is consensus toward an algorithm term, the American computer scientist, Harold Stone has a commonly accepted definition according to an article

in the MIT review (Lum & Chowdhury, 2021), namely: “An algorithm is a set of rules that precisely define a sequence of operations.”

But AI is also a political object as defined by Tournay (Tournay, 2020): “artificial intelligence is a political object because its developments challenge the organization of our society (polity), its political communication (politics) and its public policies (policy)”.

To understand how political decision-makers develop strategies and public policies, we started with the recommendations of the UNESCO. Since its creation in 1945, this organization has been competent in international education. Indeed, the Organization attempt to orientate the public policy makers. It promotes educational systems that adapt to a rapidly changing world through a holistic and egalitarian vision of lifelong education.

1.2 Artificial Intelligence in Education (AIEd)

As Tournay's definition shows (Tournay, 2020), education is also impacted by artificial intelligence (Chen, Xie, & Hwang, 2020). Thus, AI in education can be considered, according to (Chen, Xie, Zou, et al., 2020), as a combination of three major fields and one interdisciplinary field (Figure 3).

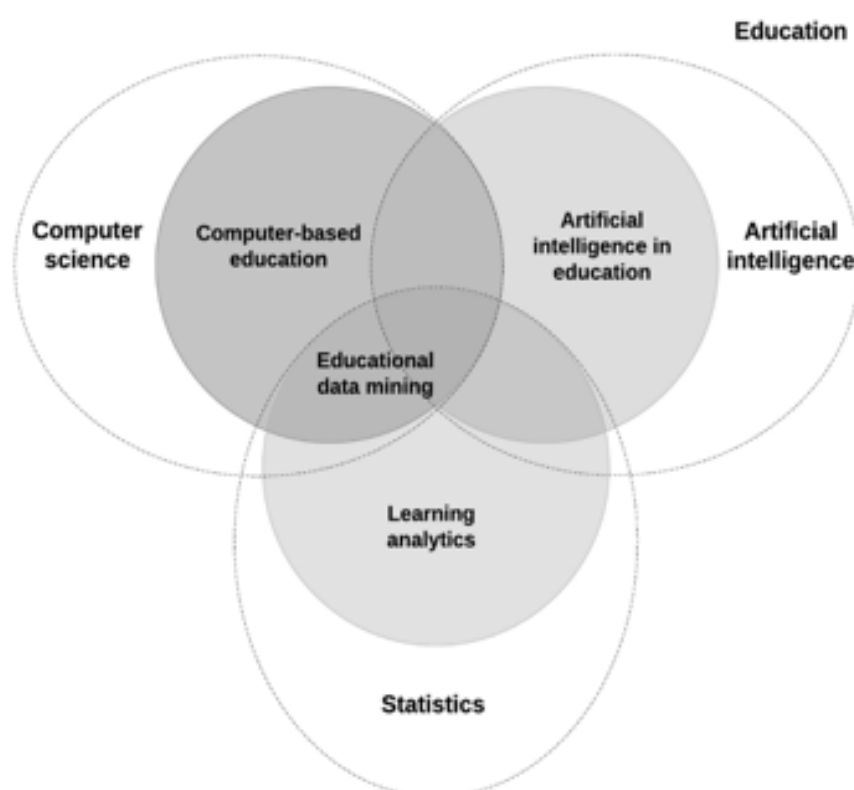


Figure 3 The relationship between AIEd, EDM, CBE, and LA. (Chen, Xie, Zou, et al., 2020)

A 2022 OECD report, in the “Trends Shaping Education” collection (OECD, 2022, p. 59), a triennial publication, questions the relationship between AI systems, decision-making and school leaders:

Education is increasingly becoming digitalised and ‘datafied’. What does this mean for the decision-making power of local actors (e. g. school leaders, teachers) compared to data owners/brokers (e. g. digital platforms and services)? Will power relationships between public and private providers of education shift?

AI systems are increasingly being used to make decisions in education (e. g. student assessment, allocation of pupils into schools). How effective and fair have the

outcomes been so far? Are we auditing these algorithms? Which situations should prioritize human intervention?

In view of these elements, we wonder how a school leader that applies public policies (Boussaguet et al., 2019) in his secondary school may use artificial intelligence?

1.3 Research Question

How our research question, for this literature review, deals with the evolution of AI for policy makers in education, according to the UNESCO reports since 2019?

From this general question, three other questions emerged:

- 1) How is AI in education is defined in the reports selected for our review?
- 2) What are the main recommendations and their developments?
- 3) At what place and mention of the role, the headteacher appears in these reports?

2. MATERIALS AND METHODS

As a preamble, the UNESCO concept note of the "international conference on artificial intelligence and education to plan education in the age of AI: a leap forward", is an introductory text to the conference which took place in Beijing on May 16-19, 2019. It sets the context and specifies the aims and objectives of this conference. The expected deliverable is a summary document that will present the results and achievements of the conference. "High-level representatives of member states will be called upon to develop and adopt an outcome consensus document". This final document will be our starting point. That's why, 2019 will be the reference year.

The first step will consist of a review of the reports, in order to determine our selection criteria. The second step is the creation of a reading synthesis grid, that might provide an answer, even partial, to the sub-questions. Therefore, to confirm or refute this grid, we will introduce a textometric analysis of the report summaries using the Iramuteq software.

Finally, the textometric result's which consist of the number of occurrences of the different words, of the five reports, will carry out a word cloud, that lead to a graphic comparison analysis.

2.1 Method for reviewing UNESCO reports

Preliminary, we did a search using the Google Scholar® search engine to verify the existence of UNESCO reports devoted to artificial intelligence in education. To do so, we will enter the terms "UNESCO and AI and education" with the starting date being 2019, which corresponds to the Beijing consensus. The search engine displays some 18,000 results. As we have decided to initially study only UNESCO reports, this time, we proceed to a review directly from the UNESCO site with a request in English and the use of the Boolean "and": "artificial intelligence and education and policy".

Indeed, to be selected for the literature review, the reports must, in addition to dealing with artificial intelligence in education, be a source of recommendations for policy makers. The starting year is 2019, the year of the Beijing Consensus.

Thus, the five ratios (R1, R2, R3, R4 and R5) which correspond to our criteria are:

R1: UNESCO. (2019). *Beijing Consensus on Artificial Intelligence and Education (UNESCO, 2019a)*

R2: UNESCO. (2019). *International conference on Artificial intelligence and Education, Planning education in the AI Era: Lead the leap: Final report (UNESCO, 2019b)*

R3: Pedró, F., Subosa, M., Rivas, A., & Valverde, P. (2019). *Artificial intelligence in education: Challenges and opportunities for sustainable development*. Unesco (Pedró et al., 2019)

R4: Miao, F., & Holmes, W. (2021). *International Forum on AI and the Futures of Education, developing competencies for the AI Era, 7-8 December 2020: Synthesis report—UNESCO (Miao et Holmes, 2021)*

R5: Miao, F., Wayne Holmes, Ronghuai, H., & Hui, Z. (2021.). *AI and education: Guidance for policy-makers—UNESCO (Miao et al., 2021)*

2.2 Report analysis method

According to our research question, we have constructed our own report analysis grid (figure 4). It is completed with each of them and should enable us to answer our research questions.

Report title	
Year	
Languages)	
Link	
Context of the report	
Report target(s)	
Previous report?	
How is IA defined?	
Objective(s) of the report	
Recommendations	
New contributions compared to previous reports	
Quote(s) and/or illustration(s) to remember	
World cloud after Iramuteq treatment	
Analysis of similarities after Iramuteq treatment	

Figure 4 Report analysis grid

However, the narrative literature review presents biases (Hoarau et al., 2021) and (Nicki, 2007). Though, to verify our first analysis, we will subject each summary of the reports to a textometric analysis (Lebart et al., 2019) using Iramuteq software.

We will retain the word cloud with term frequency and similarity analysis for the general context of the report summary (Mayaffre, 2014).

3. RESULTS INTERPRETATION

Our starting question is how are UNESCO's recommendations on artificial intelligence in education evolving from 2019 to 2021? It breaks down into three questions and we will now see how our analysis allows us to answer them.

3.1 Question 1: How is AI in education defined in the literature review reports?

The target of the reports is policy makers but also the general public, so it can be assumed that the notion will be defined at least for non-specialist readers.

Reports R1 and R4 do not define artificial intelligence.

The R2 report devotes two lines to it and makes a link with the 4th industrial revolution but without defining it either (Kohler & Weisz, 2018).

The R3 report provides a brief introduction to the history of artificial intelligence and clarifies the terms machine learning and learning analytics as technologies.

Finally, the glossary is interesting because it sets out definitions which are themselves taken from UNESCO writings.

The R5 report is the most complete because from its introduction it presents the different artificial intelligence techniques (figure 5) and a classification by domain (technology)

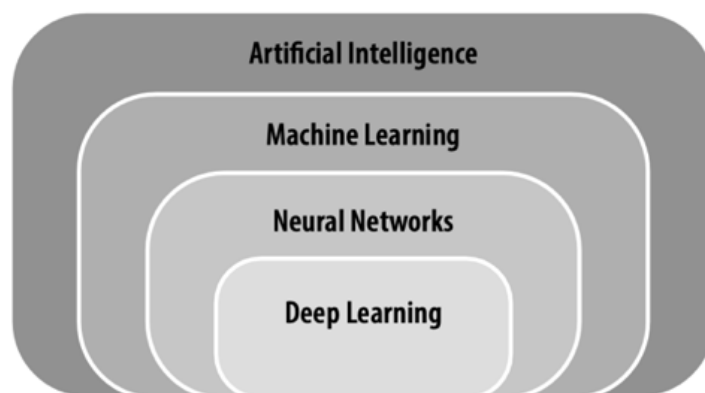


Figure 5 the relationship between artificial intelligence, machine learning, neural networks and deep learning. (Miao et al., 2021)

The ontology is different from the one proposed by the International Observatory on the Societal Impacts of Artificial Intelligence and Digital Technology (OBVIA) for its dynamic mapping in AI (OBVIA, s. d.) (Karsenti et al., 2020).

For this first research question, we retain that a definition of AI in education is not necessarily define but evolving like the classification domains.

3.2 Question 2: What are the main recommendations and their developments ?

This is the opportunity for us to see how the recommendations relates to each other's. In other words, if they are identical from one report to another or if there are minor or major differences?

On this point, the comparison of the word clouds elaborated with Iramuteq will be useful.

The first report is very general in scope with five recommendations that lay the foundations for a whole-of-government approach, where AI is at the service of personalizing lifelong learning. Moreover, there are recommendations for training teacher to work with artificial intelligence systems. In line with an article by Karsenti (Karsenti, 2018)), the question of the urgency of training teachers in AI was raised.

Artificial intelligence can be viewed in terms of opportunities and risks for societies. Though, education has a fundamental role in training citizens to understand all the potentials and risks of this new technology and build sustainable societies. On these last points, we find the questioning in the preamble of the OECD report (OECD, 2019) on the role of education in preparing our societies for the age of AI.

The second report recommends ten recommendations. This is the final report of the Beijing consensus conference, where the future of education will be improved by the artificial intelligence in a goal of achieving SDG4.

Hence, the report recommends guiding policies and strategies on AI and education, building international partnerships and ensuring fair, inclusive, and transparent use of AI.

Recommendation 9 emphasizes transparent and auditable ethical use of data and algorithms in education. The technical report (Becker et al., 2020) on *Parcoursup* illustrates this need for control and transparency of algorithms in education.

Finally, AI is perceived here as an “opportunity” with 5 occurrences in the summary and the term “risk” has disappeared from the occurrences of the summary whereas each of the two terms had an occurrence of 3 in the previous report.

The third report no longer establishes recommendations but six challenges for the integration of AI in education through informed and appropriate policy responses with the aim of achieving SDG 4.

This marks two new directions: making research in education meaningful. Thus, it reaffirms the need to train teachers in AI and its reciprocity “preparing AI to understand education”. In other words, it invites cooperation between teachers and Edtech for applications that meet the needs of teachers in the service of student learning (Collin & Marceau, 2021)

The fourth report is published in 2021, following an international forum on AI in education held in December 2020. It is written in a new context, that of the pandemic and its consequences on the education (Schleicher, 2020).

The Forum builds on the Beijing Consensus to share AI policies and practices in education with a particular focus on the skills required in the age of AI and the strategies to be implemented to prepare all people to live and work with AI. The nine recommendations in this report reaffirm the principles of inclusive, equitable and ethical use. What is new is the recommendation to nation states to adopt national strategies on AI in education. At the end of 2020, 27 countries had published national strategies and an analysis is presented in the CIFAR (Canadian Institute for Advanced Research) reports (Dutton, 2018) and (Kung, 2020). The strategies are analyzed regarding eight areas of public policy, bearing in mind that education is not a domain. It will therefore be interesting for us to follow the evolution of this UNESCO recommendation. Finally, the report also recommends mapping the risks (15):

“Furthermore, the international education community should do more to review the profound impact of AI on education provision and management, teaching, learning, and assessment – including a charting of the potential risks”.

The notion of risk is part of a “by design” approach so that the use of AI is done in accordance with educational principles and guarantees ethical and responsible use (Berendt et al., 2020). The fifth report will also be published in 2021. Although, it is also based on the implementation of the Beijing consensus, with an interesting reminder of the objectives of the consensus in the various chapters. This document goes much further than the previous ones in the recommendations to political decision-makers, of which there are nine. As we saw for question one, a chapter is devoted to the definition of AI, associated techniques, technologies and another one on emerging practices in AI and education, based on a benefit-risk assessment.

Transnational and regional policies related to AI and education developments are diverse but can be categorized as taking one of three approaches: stand-alone, integrated, or thematic (figure 6).

5.1 Approaches to policy responses

Cross-national and regional policies addressing AI and education developments are diverse, but may be loosely categorized as adopting one of three approaches: independent, integrated or thematic (see Table 3).

■ Independent approach

Having stand-alone AI policies and strategies, such as the EU's 'The Impact of Artificial Intelligence on Learning, Teaching, and Education' (Tuomi, 2018), and China's (2017) 'New-Generation Artificial Intelligence Development Plan'.

■ Integrated approach

Integrating the elements of AI into existing Education or ICT policies and strategies, such as Argentina's 'Aprender Conectados' (Ministry of Education, Argentina, 2017).

■ Thematic approach

Focusing on one specific topic relating to AI and education, such as the EU's General Data Protection Regulation (GDPR).

Figure 6 Approaches to policy responses (Miao et al., 2021)

The thematic approach corresponds to that of the European Union and the General Data Protection Regulation, a 2016 text implemented in 2018 in EU member states (Berendt et al., 2020).

If the report insists on a systemic vision and a prioritization of policies in IAEd, it also introduces the idea of carrying out experiments and documenting them with conclusive evaluations, which brings us to question 3.

3.3 Question 3: Is the role of the headteacher mentioned?

In R3, the role of the headteacher is present in the proposed definition of an EMIS:

An Education Management Information System (EMIS) is an organized group of information and documentation services that collects, stores, processes, analyses and disseminates information for educational planning and management. It is widely used for education leaders, decision-makers and managers at the regional, local and school levels and for the generation of national statistics (Pedró et al., 2019)

The R3 and R5 reports cite the EMIS and the report by (Villanueva, 2003). The latter provides information on the role of the headteacher in the EMIS process (Figure 3.1 Information Needs of Different Decision-Making levels, p 17) presented as a decision-making tool. However, it was written in 2003, so the technologies described seem obsolete to us and do not fit into our object of study, namely a system with an intelligent algorithm.

The R5 proposes to integrate AI technologies into education information and management systems. Thus, these systems will be more efficient, more robust, and more predictive (evidence data) in order to guide decision-making to better meet local educational needs. The report insists on a holistic view of systems with an EMIS and LMS interfacing. It concludes that these systems must be inexpensive and lighten administrative burdens in order to derive only benefits from the use of AI while guaranteeing an ethical and responsible use of data.

3.4 What these results tell us?

What is common to the five reports are their general orientations which are all in line with the Beijing consensus of 2019 ?

During our first analysis of the relationships with the reading grid, we hypothesized that opportunity and risk were equally important. The textometric analysis of the summaries of the five reports qualifies this hypothesis because opportunity has 16 occurrences while risk has 10.

Thus, when we no longer analyze independently but simultaneously the summaries of the five reports in Iramuteq, we observe that the first fifteen occurrences are: AI, education, datum,

learn, development, develop, policy, human, skill, system, country, international, ethical, technology and teachers.

They are repeated and extended to all occurrences with a number more or less than 9 to obtain the global word cloud of the literature review (figure 7). The analysis of similarities (figure 8) confirms our analysis grids with reports centered on the occurrences of artificial intelligence in education at the service of learning and decision-makers in a global policy that respects human rights.



Figure 7 World cloud of the 5 reports, Iramuteq

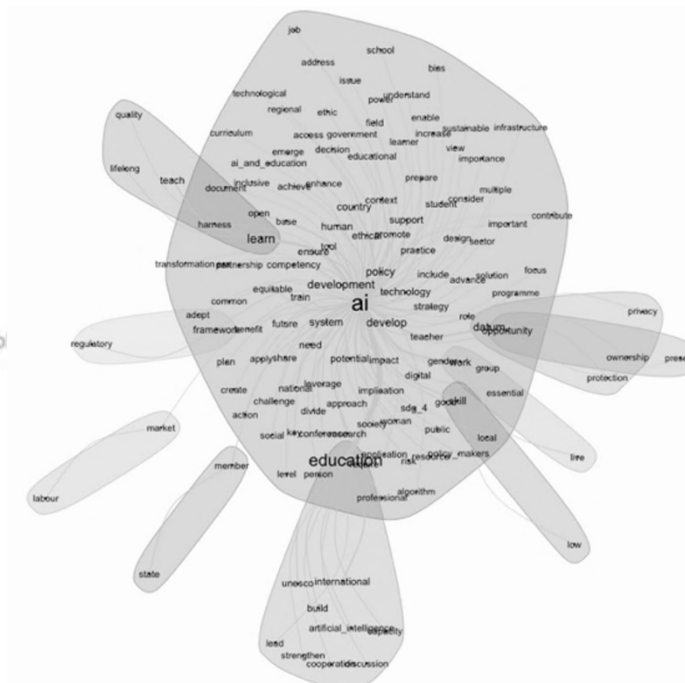


Figure 8 Analysis of the similarities of the 5 reports, Iramuteq

Finally, we can represent the evolutions of the main occurrences in each report by the following graph (figure 9):

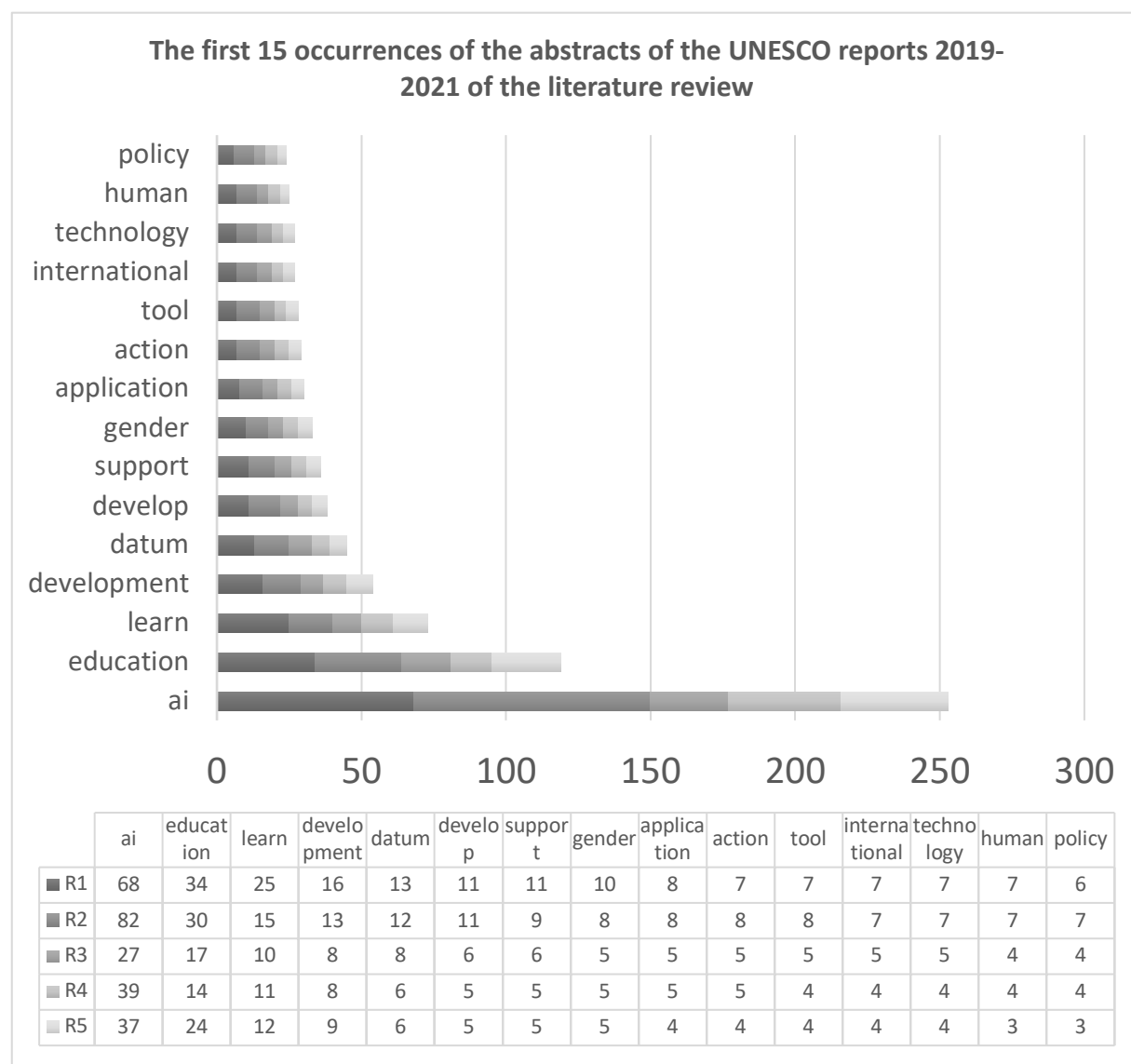


Figure 9 Graphic representation of the first 15 occurrences of the abstracts of the UNESCO reports of the literature review

The occurrences of ai and education are very present because they represent the very heart of the subject. The other occurrences remain in the same proportions. Thus, the discourse on these points is constant in the five reports.

The reports considered in this narrative literature review raise the question of how education can prepare individuals to live and work effectively with AI and build sustainable societies. Contextually, the documents studied reaffirm that the use of artificial intelligence in education contributes to the achievement of objective 4 of the SDGs (Education 2030). Those for 2020 and 2021 (R4 and R5), were written during a pandemic and this cyclical element is very present in the writings, either through examples of answers to the health crisis in certain countries or by putting the pandemic into perspective.

This is not the subject of our literature review, but we will have to look at the link between the adoption of artificial intelligence in education and the health crisis (Tan & Chua, 2022).

4. CONCLUSION AND PERSPECTIVES

The common objective pursued by these reports is to help policy makers, through recommendations, to deploy AI in education in an inclusive, ethical, and sustainable way to develop the skills needed in life and at work in the era of AI. They all affirm the need for a global policy (artificial intelligence strategy in education) that makes it possible to seize the opportunities of AI and manage its potential risks. The latest report emphasizes the transformation of education and training systems since the health crisis and how AI can be an object at the service of this change.

The local actor level, which is the head of the school establishment is very little mentioned. The reports focus their recommendations on the use of AI in the service of learning and therefore plead for an introduction into the practice of teachers. If the data must be collected and used transparently and ethically, they are presented as indicators for the services of political decision-makers but not as a decision-making tool for the headteacher.

We will continue our thesis work by questioning the place of AI in education in France's national strategy and more particularly whether there are recommendations for school heads to take up this geopolitical issue?

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