

IL vs. IA

Information Literacy vs. Artificial Intelligence

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To misname things is to increase the world's misfortune (Albert Camus)

SUMMARY

This is a spell on the importance and urgency of **information literacy** (IL). The elements that support this advocacy efforts fall into five categories: 1) the myth of the expertise of **digital natives** and its negative consequences in educational terms; 2) the erroneous vision of the **digital divide** focusing exclusively on access without considering the linguistic and content matters that cannot be addressed by technical approach but thru education; 3) the issue of **information ecology** and the threat posed by unethical Internet traffic to global warming; 4) the issue of the **harmful evolution of the Internet** and how unethical user behaviors are transferred to the non-virtual world, threatening democracies; and finally, 5) the dangers that the rise of **artificial intelligence** (IA) are bringing, in terms of hidden biases and release of citizen control over decisions resulting from IA based applications. The conclusion is a call for a massive and articulated IL effort aimed primarily at **youth education**.

Keywords: information literacy; digital natives; digital divide; artificial intelligence; information ecology; evolution of the Internet

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INTRODUCTION

Today about 60% of the world population has access to the Internet (an estimated total of 4.6 billion of the 7.8 billion people on the planet). The data varies by continent from about 95% in North America to less than 40% in Africa¹. However, the discourse to fight the digital divide remains unchanged: the desire to connect the entire world without further concerns towards languages, content and user capacities. We do not have global indicators that reflect the average level of competence of Internet users, especially in terms of managing information, validating sources, evaluating accuracy and quality, or transforming information into knowledge and decisions. Scattered and localized studies suggest that the average general level could be below that required to navigate with solvency the ocean of digital information. At the same time, the media is invaded by false news, hate and racist speeches. Digital literacy², which qualifies the ability to use digital tools fluently and information literacy (IL), a broad set of skills that allow searching, evaluating and using information in order to enrich own or universal knowledge, does not seem to be a greater concern of promoters of universal access to the Internet. There is a belief that young people, who have been given the expression "*digital natives*", assuming that they have a kind of innate expertise in the use of these tools, do not need to be educated to use the Internet. Their abilities are even believed to be above those of their own educators, who have been called "*digital immigrants*" as a stigma linked to their alleged incompetence. This binary classification between natives and immigrants has left aside what we will call the "*digital dinosaurs*", those still numerous who contributed to or inhabited the digital world between the 80s and the 90s or sometimes, even more recently, on the way to its construction and development. These dinosaurs can rival the natives in terms of ability to use technological tools and, in addition, they have what most natives lack: the ability to work inside a wealth of information where the best is next to the worst, without being impressed by the number of "likes" or virtual fame and capable of mastering the validity and value of information and knowing how to metabolize it into knowledge.

The skills, so necessary nowadays, to move in the virtual world in an effective, efficient and ethical way, which are grouped under the theme of IL, generally remain excluded from the educational programs that the natives receive. At the same time, studies indicate that without an adequate educational effort, the level of informational competence naturally tends to decrease, a sign of the urgency of correcting this situation. What follows is a set of documented arguments to show that IL is a major requirement for digital citizens, and specially young people.

DIGITAL NATIVES VS. DIGITAL DINOSAURS

Magnetic resonance technology applied to medicine has allowed remarkable progress in the diagnosis of many diseases, allowing a very precise vision of deep layers in the human body, for example, joints or the brain itself. As a side effect, this technology has become a first-rate tool for studies related to psychology, thanks to its ability to visualize the parts of the brain that are activated as a consequence of a specific activity. A first study, carried out in 2013, sheds light on the subject at hand. La Recherche presents information about the brain behavior of people during some specific tasks related to digital performance (see [5]). The

¹ All the data mentioned above comes from the same source, the ITU (International Telecommunication Union).

² Also called media literacy by UNESCO.

experiment involves both people with little digital experience and others well experimented, in order to allow comparisons. The results are impressive and confirm some educators' intuitions about the fact that the digital environment is not intrinsically favorable to the teaching-learning process and that, on the contrary, its use in a pedagogical context requires additional educational elements.

Analysis of hotspots in the brain reveals that conducting multiple tasks in parallel (in the example, a Google search, plus an SMS, plus reading a text) weakens the ability to process information. In the brain, only the cingulum cortex (which manages hindsight) and the prefrontal cortex (which manages planning and foresight) catch fire, the rest remains inhibited.

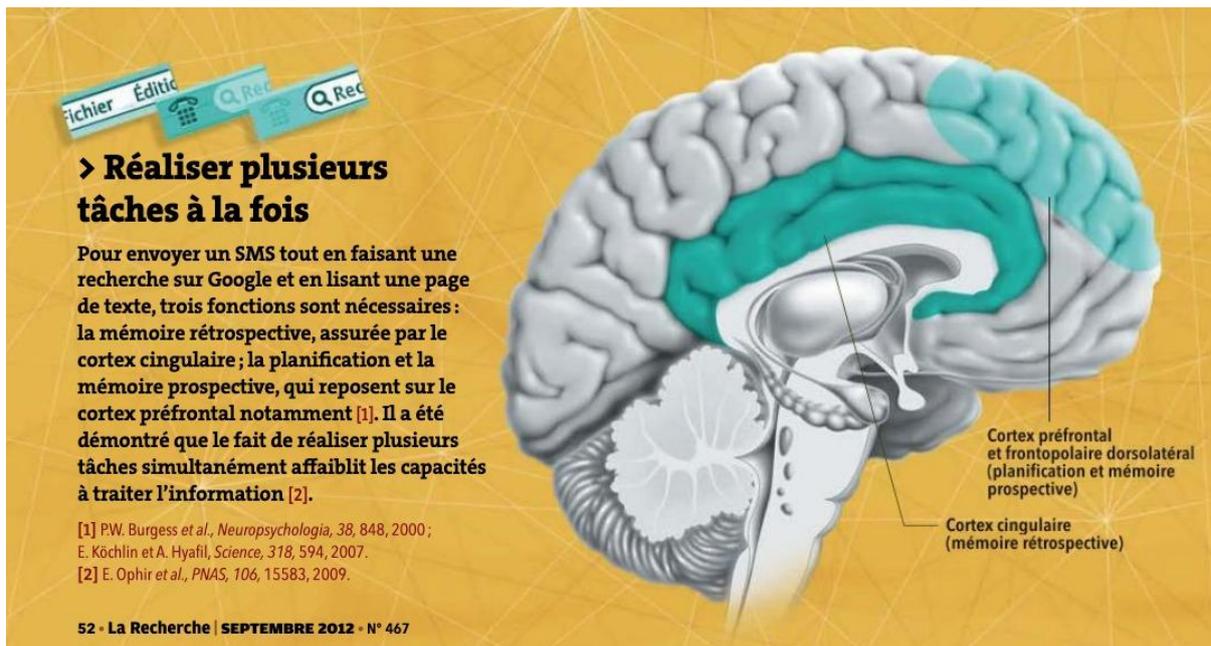


Figure 1 : Multiple tasks in parallel

Instead, the search for information mobilizes an impressive number of parts of the brain, although experience shows that the extent of activated zones depends strongly on the experience level of the person under scrutiny. In other words, an information search professional enters a state of high brain resonance during the task while a novice remains in a very primitive state in terms of brain resources allocated.



Figure 2: Information search

As for participating in social networks, one can see that a different and very localized part is activated in the brain (amygdala and temporal cortex).

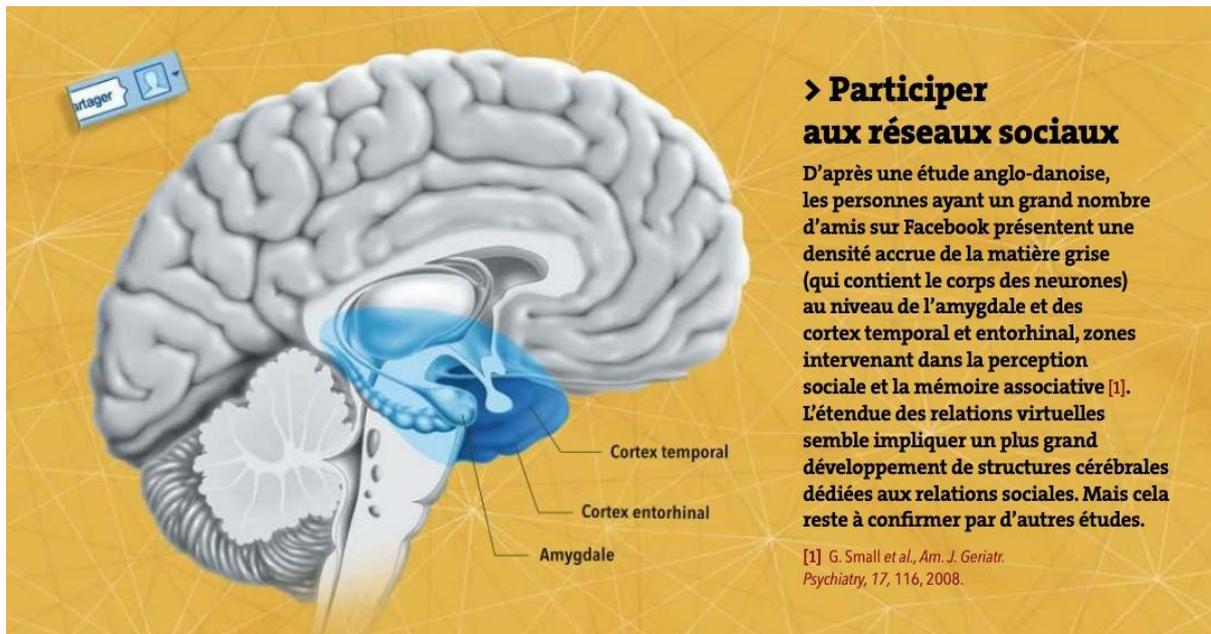


Figure 1 : Participate in social networks

Finally, video games develop a very sharp competence in visual perception while also mobilizing important spaces of the fronto-parietal cortex.

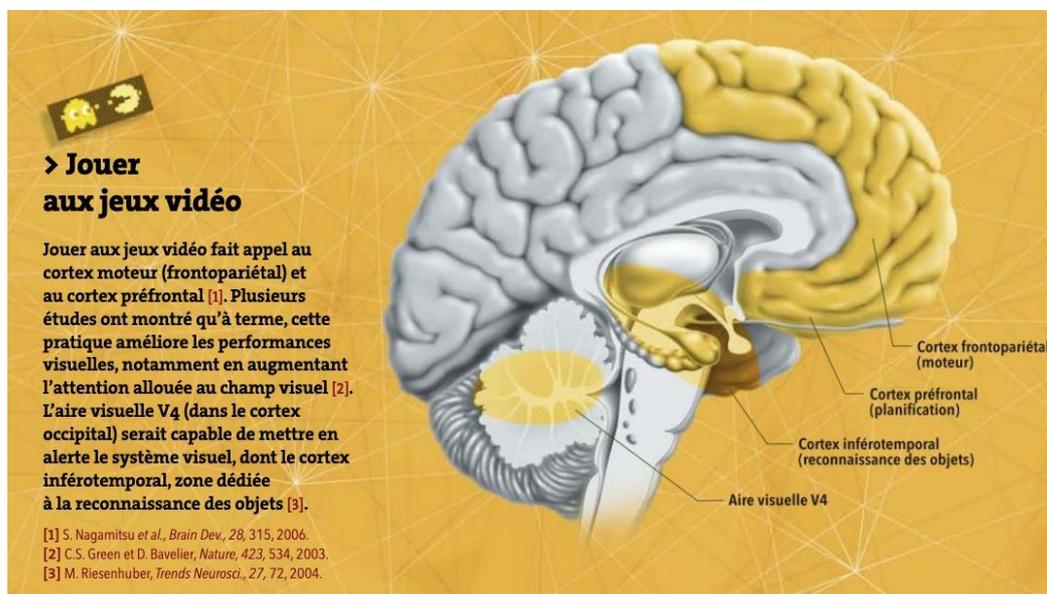


Figure 2 : Video game

The most interesting thing about the study, as far as the focus of that paper is concerned, is that it makes the comparison between natives and dinosaurs³ during reading and information search activities.

³The terms are not specific to the source but an adaptation of its experiments to the case of our study and it must be made very clear that it is a simplification based on a statistical vision of reality. A young person could have

Clearly, reading is one of the human activities that mobilizes the brain in the most massive way. The only activity that could overcome this intense and extensive degree of brain mobilization is the search for information, when it is carried out by a very experienced person. It is not surprising since what is asked of the brain is the same interpretive concentration as for reading, but with additional and high-level activities in parallel: evaluation, bonding, memorization, etc. However, that cerebral hyperactivity does not apply to natives⁴.

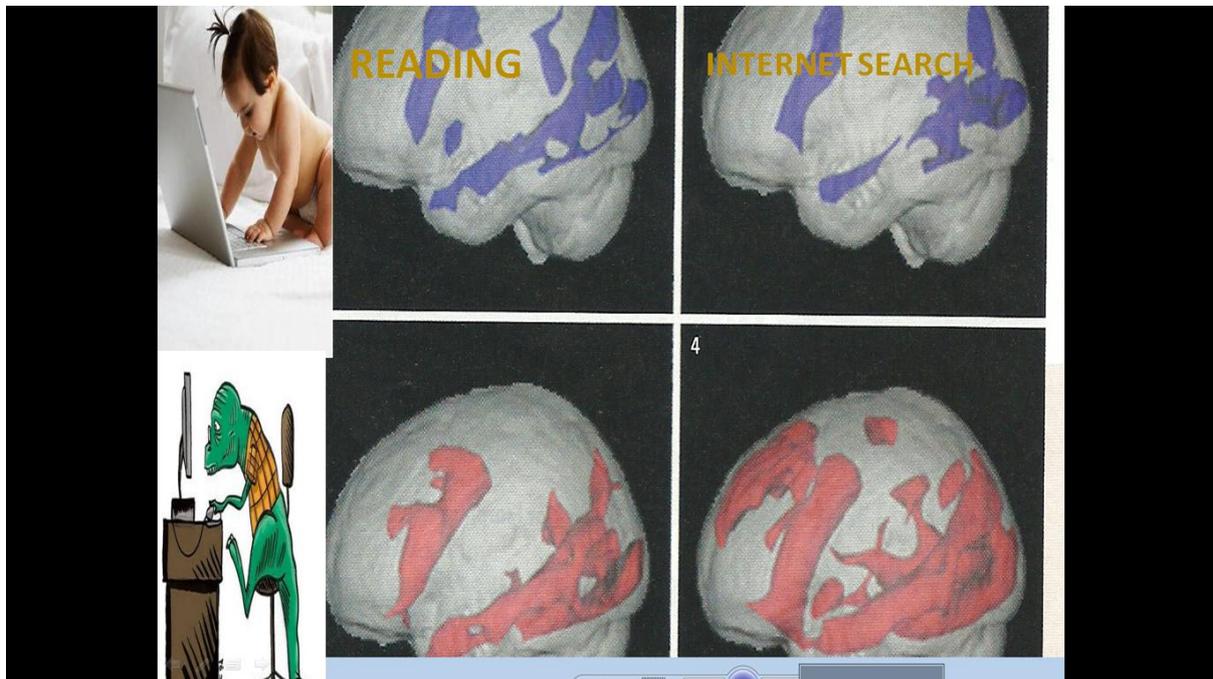


Figure 3: Comparison reading vs. search

Leaning first of all on terrain observation we can characterize the differences between digital native and dinosaurs in the following way (being clear that all characterization are by nature a simplification focused on the extremes in terms of competencies):

NATIVE PEOPLE	DINOSAURS
Fluent in digital interfaces	Fluent in search of information
Fluent in iconic language	Fluent in information evaluation
Comfortable with mobility	Comfortable in fixity
Parallel-synchronous	Asynchronous
Info-diabetic ⁵	Good information metabolizers

Table 1 : Comparison digital natives vs. digital dinosaurs

This classification was elaborated prior to reading the work published by La Recherche and it has been a pleasant surprise to discover that several of its elements in have been confirmed by

received the appropriate education and created the experience to have a professional handling of information (and reciprocally) but we acknowledge that this is not the general case.

⁴The teacher's experience suggests that the first obstacle is the training of rapid reading on screen, more complex than on paper because it is not linear. Additionally, the ability to determine the best search strategies and to evaluate the results are highly complex tasks.

⁵ The concept of info-diabetes has been formulated in 1992 by Pablo Liendo (see [1]) and dictates that in the same way that a diabetic person urinates sugar due to the inability to metabolize it into energy, an info-diabetic person is not capable to retain the information received and metabolize it into knowledge.

the analysis of brain behavior. The work cited in particular states that the parallel-synchronous behavior of many natives (who, for example, chat with several people while watching a video and reading a document) causes a loss of concentration that is clearly measured as a limitation of brain activity and is antagonistic of a good learning process.

The competencies marked on the side of digital dinosaurs, and which are largely lacking in digital natives, are precisely, and not coincidentally, those that the IL is in charge of providing (or that which years of experience in the field allow to build without prior training). The myth of the digital natives holding an innate ability to handle information is sitting on a deep misunderstanding and is toxic. It is one thing to manipulate keyboards, screens and icons with your hands, another to manipulate concepts and knowledge with your mind. It is one thing to circulate news without being able to determine its veracity, another thing to know how to find out the sources, evaluate the information, eliminate false information and maintain a critical spirit, including for validated information from the best sources.

A study has been carried out in 2002 (see [4]) to measure digital and informational competences of students and at the same time of their parents. It effectively shows high digital skills in students and low in parents; at the same time, it shows very low information skills in the students and much better, although perfectible, in the parents. In 2007, the authors repeated the measurement with the same instruments and exactly the same target population. On the digital skills side⁶, the parents managed, with 5 years of efforts, to get closer to the level of their children, while the latter maintained their good level. On the informational competencies side, adults slightly improved their performance while youths showed a **visible decrease** in their competencies, which should give rise to alert and serious concern. It is understandable that repeated use allows improving digital skills, however, use does not teach informational skills on its own; on the contrary, without proper education the user, below a certain threshold, is locked into bad practices and spurious information bubbles. That study deserves to be replicated multiple times and if its alarming results are replicated in different locations or circumstances it should lead to the conclusion that AI is not just a requirement but an emergency!

We have conducted a study in 2018, in the Dominican Republic, to measure the digital and informational competences of education students and teachers⁷. The results do not allow comparison over time, but suggest that although the people who teach have a better level than those who study, the difference is not marked. The average ratings are relatively weak in both cases, especially in the informational aspect. Once again what is highlighted is the need for IL, first to the teachers and then to the students.

A notable part of the recruitment of international Islamist terrorism targets young people living in Western countries and is carried out using the Internet as a means of propaganda and remote coordination. It cannot obviously be claimed that IL is the remedy for this situation and it is clear that a set of factors must explain how young people from democratic countries allow themselves to be convinced of the validity of such a hateful vision and lead them to

⁶Note that the authors use other terminology and include informational competence as an element of digital competence. Here we adapt the presentation of their results to our terminology.

⁷The work that has not been published yet is based on very complete questionnaires (56 questions) submitted to a random panel of more than 2000 students and more than 200 professors methodically distributed among universities, disciplines, age, region and academic level. The instruments separate each type of competence (information, education, application, software, hardware) and include self-assessment, cross-assessment, and control questions. The study will be published on the site <http://funredes.org>.

become perpetrators of violent crimes, including a number of cases when they commit both suicide and crime by explosion of artifacts. It is reasonable however to think that IL programs could have a positive effect on a proportion of these fanatical young people "radicalized" through the Internet.

DIGITAL DIVIDE

In 2007, we published a work of analysis reflecting the experiences and reflections of the Networks & Development Foundation⁸ about the digital divide, during the period 2000-2007. The main lines of this work remain current two decades later, although (or because) the Internet has evolved in a profound and disastrous way (see [6]). The paper identifies the eleven obstacles to overcome in order to fully control the digital divide within a human development perspective (see figure below and see [3] for more details)⁹. The conclusion is that overcoming the first three obstacles regarding access and its technical and financial sustainability, all the following have to do with an educational effort. Functional literacy for the fourth and then the content and linguistic gap (why would I want to access the information on the web if I cannot do it in my native language and/or if I will not find content that reflects my language or my culture?). All of the following obstacles, from 6 to 11, appeal to education in the digital world and IL.

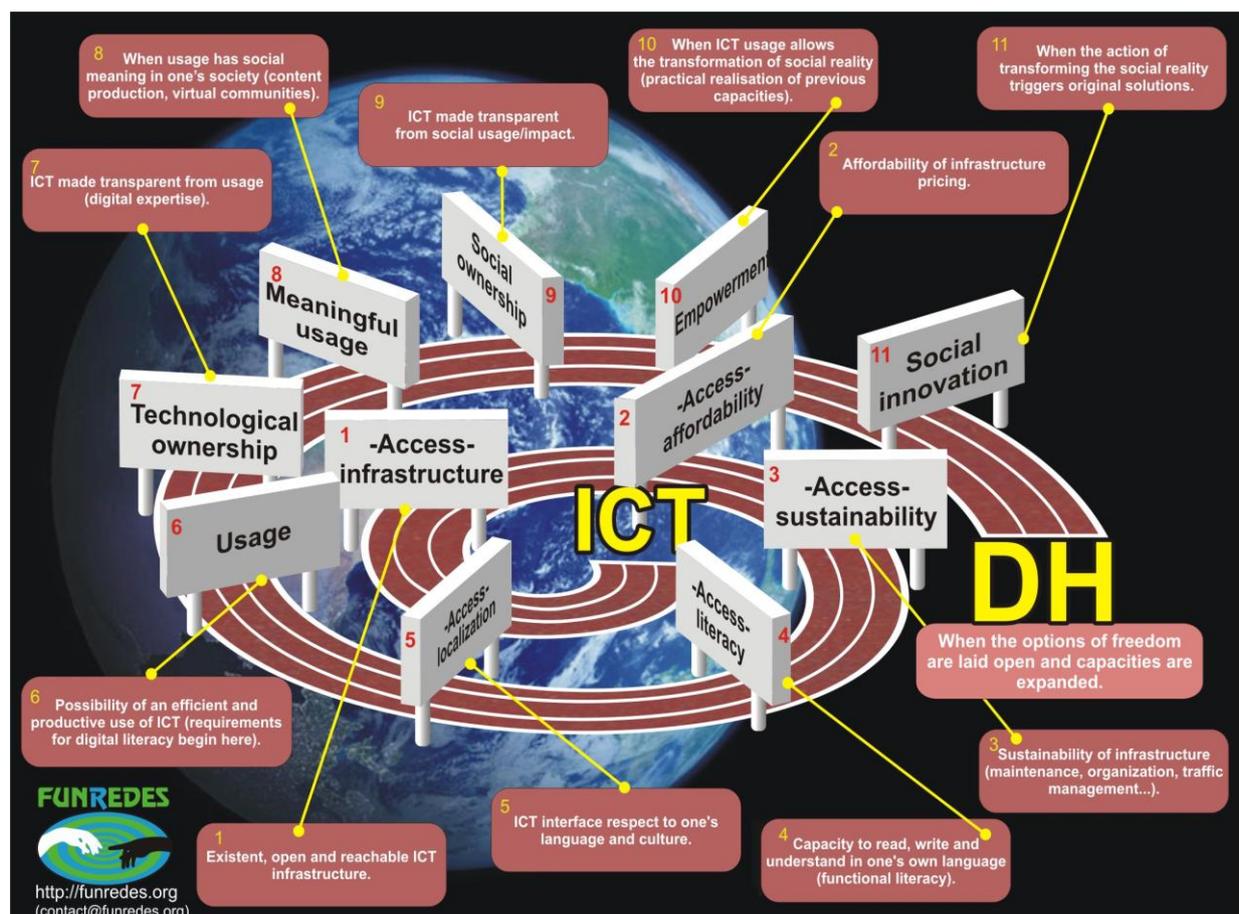


Figure 4: The obstacles to overcome the digital divide

⁸ <http://funredes.org>

⁹ Incidentally, the paper proposes definitions for many of the associated concepts, including information literacy.

The obsession with the right of access and the absence of focus on information is the cause of the existing linguistic and content divide. It has meant that these matters have been neglected and confined to limited groups of specialists, when they were obviously prevalent and of general interest.

To worry only about access is to play the game of electronic equipments or bandwidth vendors as well as application providers, first of all, the GAFAM¹⁰, without attending to the ethical needs of their offers and reducing the options for user participation. Overcoming the digital divide should mean, in addition to provide access, having empowered users and digital citizens aware of the complex challenges of the digital world; this only goes through IL programs.

INFORMATION ECOLOGY

The expression "*information ecology*" has been used by several authors since the 90s and there is no agreed definition. Here we refer in particular to ethical behaviors on the Internet, related to information, and the impact of the Internet on the environment, concepts that we are going to bind in sequence. In 2007, the first studies came out (see [2]) warning that electricity consumption generated by the Internet, directly (from the user side) and indirectly (from the service provider side), could participate in global warming to the same level as air transport (its impact was evaluated at 2% of the total). Obviously the exponential growth of the Internet and the strong trend towards relatively more multimedia traffic, very consuming of bandwidth, suggests a strong growth of this caloric impact. On the other hand, the GAFAM had two powerful incentives to improve their electricity consumption patterns: 1) this represents a significant part of their costs and 2) the pressure of public opinion about global warming. They certainly invested in moving their data centers to appropriate places to control that consumption. The latest figures¹¹ mention however 3.7% as the impact figure, which is less than what could be expected but which is still practically the double of 13 years ago.

Part of Internet traffic can be considered unethical: spams, chains, redundant looping, duplication of pages and files downloads. We have tried in 2007 to quantify this unethical traffic in terms of percentage of the total and, although we consider that a third figure is probable, we have not been able to conclude this study with reliable data. If we consider, as a working hypothesis, that the third of the traffic could be avoided with a healthy ecological management of the Internet, we can establish that IL programs that naturally include this aspect could have a notable positive effect in the fight against global warming.

Attention to the ecological would also include the treatment of good practices (not all the bad practices being considered unethical). Take the example of using search engines. In 2007, it was evaluated that the electrical consumption associated with a single search could be compared to the consumption of a complete laundry in a machine. If instead of paying for services on the Internet with our personal data, with catastrophic ethical consequences (see [6]), we would directly pay for the service as such, the practices would be different. The fairly common practice of searching for a document of ours on the Internet rather than on our

¹⁰This acronym brings together the great monopolies of the digital world: Google, Amazon, Facebook, Apple, Microsoft. In [6] we prefer to use the name Technology Giants to include non-western companies, especially from China and Russia.

¹¹ See https://www.lemonde.fr/planete/article/2020/06/24/1-inquietante-croissance-de-l-empreinte-ecologique-du-numerique_6043999_3244.html

own computer would then be discouraged, to take just one example. It would then incite users who produce large volumes of information to install search engines on their own computers, resulting in an energy cost several orders of magnitude smaller than when mobilizing global search engines to locate personal information.

EVOLUTION OF THE INTERNET

With Luis Germán Rodríguez we have recently reflected on how and why the Internet has moved away from the initial course and from those utopias that it carried (see [6]). The analysis identifies some kind of *end of dialogue* that has negative repercussions in the real world and begins to threaten the stability of democracies. The current dynamics, triggered by an economical model based on advertisements, favors that the predominant use on the Internet (mainly through social networks) is to market people, institutions and discourses and combat who oppose the points of view which is promoted and advertized in the digital world. People tends to turn into marketing agents of themselves and the attention is not any more given to the knowledge but rather to what produce turmoil and buzz. The noise is getting above the signals and therefore the entropy increases and the knowledge society turn into the opinion society and get closer to the disinformation society. Those analyses and reflections are developed in details in [6] (as well as the causes) and taken to the conclusion that IL is a global emergency at the same level of importance as global warming. Only digital citizens getting awareness of the stakes and how they have been dispossessed of their personal information to nurture a highly profitable business for companies more powerful than modern states, can reverse the ongoing catastrophe and redirect this evolution.

ARTIFICIAL INTELLIGENCE

Artificial intelligence has shown a spectacular boom in the past years when it has managed to abandon its first visions (and disappointments): algorithmic methods and approach towards expert systems created with the intention of transferring human expertise to the program. It has obtained remarkable results when it started investing in a way of processing closer to how the human brain works (neural networks capable of autonomous and/or deep learning) and it develops the ability to handle unprecedented volume of data with advanced statistical tools. AI specialists regain the confidence that had been lost years ago and tend to believe that there will not be many problems to resist this new approach, provided enough data can be gathered about the problem to get the substance out of them and provide more predictive accuracy than the best experts¹².

However, in this new approach that fascinates us due to its non-sequential and somewhat magical aspect, because it does not respond to algorithmic logic, interpretability¹³ of the results is difficult and that should concern us.

Unlike an algorithm that can be audited and where biases can be identified by patiently analyzing the logical sequences, it is very difficult to audit an instrument whose result depends on stochastic calculations on gigantic masses of data. Transparency can (and should) be requested from an algorithm to assess its biases and edge effects; however, the transparency of the equations that process these massive data is not necessarily going to help us understand those same effects. And for the biases to be detected it would require to

¹² There are examples of pattern recognition and medical diagnosis.

¹³ Which of all the variables have the most weight in obtaining such a result?

analyze the statistical distribution of the big data that feed those equations. The question of control of these tools then becomes very complex and it is legitimate to ask whether it will always be feasible.

In any case, it is an illusion to call intelligence the sum of individual and independent tools capable of solving each one a specific problem if there is no correlation or synergy between each tool. That the number of IA tools increases exponentially does not change that reality. On the other hand, in the face of situations that have not been contemplated in the mass of data that they swallowed to work, these tools can fail ridiculously¹⁴.

Human intelligence is able to adapt the known solution of a particular problem to another problem that does not appear to be comparable, except on some structural level that the human mind has been able to perceive. Human intelligence, in addition to transporting structural solutions between apparently different problems, is capable of linking apparently independent solutions and problems. AI programs capable of winning the best Go and chess players have emerged, which is certainly a feat. It remains that if we propose to one of those two "smart programs" a new game inspired by a creative combination of rules from the two games it will return to beginner level. It will not be able to perform prior to be fed the data of millions of games whereas the best human players would adapt in a matter of days.

We have long lost control of our personal computers: the CPU and disk are activated without stopping without having launched an application and we do not know what is happening. In most cases, programs are being downloaded into our PC in spite the fact we have not explicitly ordered an update; in the name of our security we are forced to "protect" ourselves with new versions. In the not too distant future we could also lose control of our decisions: based on our personal data (including our DNA and data collected by smart connected glasses with brain sensors) AI programs will recommend us to stop at such a place to eat, choose the person with whom we are going to sleep tonight or the rest of our life, what career should we undertake and when should we change our profession. The reality of today is that most people do not seem very concerned that an algorithm decides who their message on social networks should reach and when they should write to one or another friend to congratulate them. The terrain is prepared for a dystopian future where we will artificially transform into robots while the robots that determine us will become more intelligent entities as we evolve into more stupid.

These considerations are not intended in any way to censor current progress and IA applications, but rather to make it clear that citizens cannot abandon themselves in total confidence and without control over these developments. The stakes are enormous and the ethical challenges that arise with them are of the same size: they cannot be left in the exclusive hands of the private sector or governments. Civil society must closely monitor what is happening in IA and get awareness about ethical challenges. For this to happen an appropriate education must be part of the IL (at the same time as the minimum statistical knowledge required by the times as well as skills to understand the management of complexity). The point here is not to deepen reflections on a topic that is not within our domain of competence it is only to note that these developments must not escape citizen scrutiny which would imply an educational effort that must be integrated into IL.

¹⁴ Thus a program capable of recognizing whether a photo is of a cat can be tricked by just changing a pixel (see <https://www.bbc.com/news/technology-41845878#:~:text=The%20researchers%20found%20that%20changing,far%20wider%20of%20the%20mark.>)

CONCLUSION

We are entering an era where **disruptions** (see [7]) from the digital world can be greater and difficult to control. At the same time, society has abandoned its prerogatives in the hands of giant companies with financial and political power sometimes superior to modern states. Civil society continues to operate within a paradigm of controlling government drifts without worrying too much about what private companies do. At the same time, the Internet is reaching a proportion of the inhabitants of the planet that exceeds 50% without having really cared to provide them with the intellectual tools necessary to manage themselves fluently and lucidly in that new world. They are left defenseless at the mercy of companies that have made advertising the engine of their economic activity, capture their personal data which has become their products and can influence them to maximize their profits. Young people are at the heart of marketing strategies and are not receiving the education that would allow them real autonomy in an information society biased by the economic interests of these companies and without true control over their activities. The use of AI to further extend and potentiate GAFAM strategies for manipulating users opens perspectives that are similar to a true dystopia. All the elements converge towards the emergence of an urgent need to offer an education to the digital world (IL) and to the accelerated and amplified handling of information.

REFERENCES

- [1] P. Liendo, Un modelo conceptual para el análisis del mercado potencial de servicios telemáticos. En: Calidad, tecnología y globalización en la educación superior latinoamericana. pp.493-512. UNESCO/CRESALC, 1992
- [2] - JG Koomey, "Estimating total power consumption by servers in the US and the world", Stanford University, Feb. 2007
<http://www-sop.inria.fr/mascotte/Contrats/DIMAGREEN/wiki/uploads/Main/svrpwrusecompletefinal.pdf>
- [3] D. Pimienta, "Digital divide, social divide, paradigmatic divide", in "Human Development and Global Advancements through Information Communication Technologies: New Initiatives", pp. 33-48, DOI: 10.4018/978-1-60960-497-4- 2011
and in *Journal of ICT and Human Development*, V1 N 1, 2009
http://funredes.org/mistica/english/cyberlibrary/thematic/Paradigmatic_Divide.pdf
- [4] Y. Eshet-Alkalai, and E. Chajut, "Change over time in Digital Literacy", *Cyberpsychology & Behavior*, Volume 12, Number X, 2009
https://www.openu.ac.il/personal_sites/download/yoram-eshet/EshetandChajut2009-Changes-in-digital-literacy.pdf
- [5] F. Gracci et S. Dessert, "La carte cérébrale de l'utilisation du Net", *la Recherche*, No. 467, Pag. 52, 9/2012
- [6] D. Pimienta & L.G. Rodríguez Leal, "Rock the Internet Blues: A critical vision of the evolution of the Internet from civil society", 6/2020
<http://funredes.org/RockInternetBlues> (Spanish, French and English)
- [7] L.G. Rodríguez Leal, "La Disrupción de las Gigantes Tecnológicas - Emergencia Digital", 1/2020
https://www.academia.edu/41701222/La_Disrupcion_de_las_Gigantes_Tecnologicas_-_Emergencia_Digital