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# Open Educational Resources and MOOC for Citizen Understanding of Artificial Intelligence.

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- > CfP topics : *K-12 AI educational initiatives and projects, Didactical aspects of AI education, Best practices for training educators to teach about AI (Train the Trainer), Relation of AI education to teaching computer science and other STEM topics.*

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## Abstract.

Our whole society is, and will be, deeply impacted by digital technologies and practices. This impact is taking a new qualitative and quantitative turn with what is named artificial intelligence (AI). We must allow everyone to master, thus understand and develop a creative and critical perspective and agency in the way AI is integrated in the different domains of our lives.

We have built and now operate a citizen MOOC in AI in the broad sense, on AI foundations and applications, intended for a large public beyond the school domain, with more than 15000 participants engaged in the MOOC after three months.

We report here on this project, detailing the didactic choices (linking everyday life elements to fundamental concepts, understanding the "how it works" via online or unplugged concrete activities, making explicit how understanding the "science underneath" allows to better discuss the societal impacts) and the pedagogical method (e.g.: small conceptual videos, contaminating activities to be redone in real life, ...). We finally share learning analytics, quantitative and qualitative evaluations and explain to which extent educational science research helps enlighten such large scale initiatives.

## 1. Introduction

All citizens are and will be deeply impacted by digital science and this takes a new qualitative and quantitative turn with what is named artificial intelligence (AI). We *must* allow everyone to master, thus understand how all this works. This means computational thinking discovery and machine learning initiation. Directly inspired by the Finnish initiative to train 1% of its population on these subjects [1] and after our success in providing open and freely accessible and reusable hybrid formations on computational thinking for teachers and citizens not familiar with computer science [2] where more than 45000 persons have been reached, yielding a satisfaction level higher than 90%, we have built and now operate a citizen training in AI in the broad sense, intended to a large public beyond the school domain, with the goal of giving rise to an *ubiquitary citizen university in digital science and culture* [3].

In order to report on this project, we are going first to explain our position with respect to AI, sketching what is to be shared with everyone and then to detail more concretely in link with 21st century skills what is proposed in this formation, before presenting the method and results and discussing perspectives.

## 2. Understanding intelligently Artificial Intelligence.

Artificial Intelligence is “the science of making machines do things that would require intelligence if done by [human]” (Marvin Minsky 1968). This definition is very interesting because it does *not* address the issue of whether a machine is “*intelligent*” or not, which is an ill-posed question [7], but defines a mechanical process *with respect* to (what we consider as) human intelligence. On the contrary, the emergence of AI mechanisms question what we consider as human intelligence: For instance, a century ago, mental arithmetic was really a clever thing, to the point of proposing public performances, while pupils were heavily trained, whereas nowadays pocket or smartphone calculators make such skill much less useful, and we are mainly considering that it is nothing but very basic algorithms. The fact is that not only numerical calculations have been mechanized, but complex symbolic operations manipulating symbols and relation between symbols (so called, “symbolic” AI) and also complex numerical processes (so called, “numeric” AI) yielding mechanisms to transform speech to text, categorize and or locate objects in pictures, and so on, up to implementing high-level specific cognitive functions algorithmically.

Three key-points have to be made explicit :

- Firstly, very efficient transformation mechanisms (e.g., speech to text read out<sup>2</sup>) can be realized without “understanding a word” of what is said, being able to process information does not mean that information makes sense.
- Secondly, implemented methods, especially in symbolic algorithms (e.g., symbolic calculation<sup>3</sup>), can be in total disruption with respect to the corresponding human mental processes.
- Thirdly, is generally accepted that the more specific the task is to solve, the most efficient the algorithm will be, “general” problem solver<sup>4</sup> cannot in theory be performant [8].

We consider that sharing such epistemological ideas is crucial to help everyone build an unbiased vision of what is called AI.

In order to develop a critical and creative agency towards the way AI is changing our society and everyday life, these new tools that deeply change our society and everyday life, it is also important to understand “how it works”. We now learn creative programming at school, and this is the lever for understanding the digital world. Based on this scientific culture it is easy to explain the difference with AI mechanisms:

In the former case, the system is “programmed by the data”. Very general algorithms with a

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<sup>1</sup> <https://en.wikipedia.org/wiki/Intelligence>

<sup>2</sup> Regarding speech-to-text, it appears that our speech decomposes in a few units of sound that distinguishes one word from another in a particular language (phonem), about 50 (11 to 141 depending on the language). They form words (we use about 1000 to 3000 words daily, among 10000 to a bit more that 50000). In other words, the combinatorial is not that huge, and the fact that speech-to-text systems now pretty work, detecting phonemes and using powerful and complicated statistical modeling systems, mainly demonstrates that “read out” does not require to “understand” the speech. Interesting enough, and contrary to image recognition, the speech-to-text systems architecture does not borrow much from our understanding of the corresponding neurophysiological processes. Furthermore, “brute force” statistical calculations surpass sophisticated signal processing approaches.

<sup>3</sup> A lot of mathematical algebra is now performed using algorithms of “computer algebra”, so that mathematical engineers delegate most of the calculation to the machine, concentrating on reasoning and concepting. The key point is that the computer algebra mechanism can be very far from the human treatment of the same problem (e.g., polynomial factorization is performed over finite fields of increasing cardinality and not using rewriting rules as a human would do). Furthermore, this requires completely different skills, such as understanding symbolic algebra, reformulating the problem in an algorithmic way, interpreting the result or non result. A step ahead, the disruption is even greater with theorem prover and program formal validators.

<sup>4</sup> The contribution of the so-called “no free lunch” theorems is that it tells us choosing an appropriate algorithm requires making assumptions about the kinds of target functions the algorithm is being used for (introduce as much a-priori information as possible), whereas with no assumptions, no “meta-algorithm”, such as the scientific method, performs better than random choice.

lot of parameters can implement very specific but different functions by adjusting these parameters on a training data set (either explicitly when supervising the training, or more implicitly when either providing a positive or negative reinforcement reward or adjusting the parameters on the data set structure without supervision). Programming paradigm consists of designing an architecture with suitable algorithmic modules, setting up a learning process and feeding it up with data. This is the case for numerical data or symbolic knowledge.

This explanation illustrates the technical level chosen to explain AI mechanisms to everyone.

A step further, believing that a machine can be built to be (or to become by itself) “globally intelligent” is neither wrong nor true: It is a *belief* [9], and we are all of us free to believe (or not) this could or will happen. Furthermore, when considering this notion of intelligence, the concept is often mixed with the notion of *intentionality*<sup>5</sup> or *self-awareness*<sup>6</sup>. This belief is a recurrent human myth<sup>7</sup>, but also a scientific assumption<sup>8</sup> of “global AI feasibility”, that has driven years of research, without concrete achievement on the main subject itself, but very fruitful side effects [10]. Understanding AI is also a way to develop *critical thinking*, as discussed now.

### 3. Artificial Intelligence and the 21st century skills

At a more concrete level the formation curriculum has been organized in three sections.

- *What is artificial intelligence?* In order to gain a first understanding of what AI means and what it is not, including historical aspects. One pedagogical key point here is to insert between human intelligence and machine intelligence, animal intelligence, i.e., compare natural and artificial intelligence. Such an approach is not the most frequent, but really helps to think differently about AI. A real place to symbolic IA (e.g., formalization of knowledge, e.g., for the semantic Web) is also given, not only because it is an important domain, regarding the applications, but also because it helps to better understand how we humans can formalize our knowledge. The reasons why we can be frightened (or unboundly optimistic) by AI is also discussed.

- *How to do artificial intelligence?* Here, machine learning and data programming is introduced, without mathematics, but detailed enough in order to understand the principles of machine learning and the crucial role played by mastering data sets. Care is taken to explain all the abscons words (e.g., “deep learning” ? simply the fact a large number of calculation layers is pipe-lined from the input at the bottom to the output on the top (thus yielding a *deep* architecture) is used to obtain a compact calculation). As detailed in the next section, all notions are discovered “by doing” through activities. A large part of the section is devoted to data, their uses, the related risks (e.g., privacy, bias) always explaining how it works, to allow each of us to construct her or his own vision and opinion.

- *Artificial intelligence at our service?* Beyond the scientific and technical aspects, this section aims at better understanding the issues and the levers, in order AI to really be at the service of people. Beyond myths and rhetoric manipulation<sup>9</sup>. Attention is paid to make the distinction between what is

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<sup>5</sup> <https://en.wikipedia.org/wiki/Intentionality>

<sup>6</sup> <https://en.wikipedia.org/wiki/Consciousness> and <https://en.wikipedia.org/wiki/Qualia>

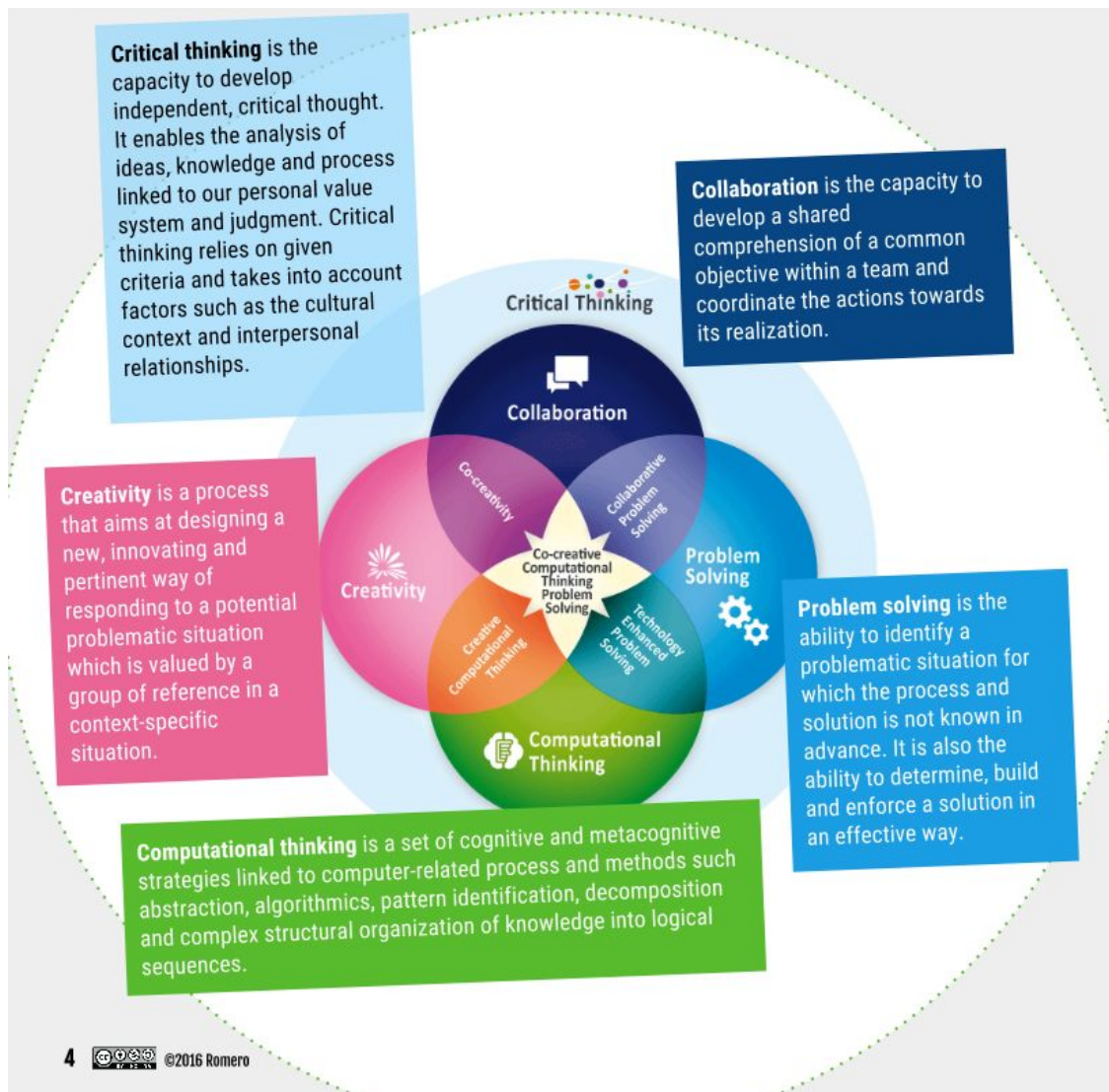
<sup>7</sup> In a nutshell, the notion of “human machine”, that slavish works for us (untill uprising), starts with slavery where humans are reduced to machines, and many ancient mythologies, and most modern religions include artificial people (e.g. golems, Pinocchio or the Frankenstein’ creature), while automata already exists in ancient civilizations before nowadays modern “robots” (from “robota”, i.e., forced laborer).

<sup>8</sup> To be entirely exact, the correct falsifiable scientific assumption is “global AI cannot exist” and the research objective is to refute this assumption. What is called “AI winters” [10] is not simply a defeat of the “global AI” dream, but an “epistemological break” in the Gaston Bachelard sense, allowing the emergence of actual powerful scientific productions.

<sup>9</sup> Let us illustrates these two aspects by a saying “if a AI robot with AI beats you, be sure that, “hidden” behind, a human takes advantage” as explained in [9], GAFAMs are act as “pyromaniac firefighters”, who launch great debates on very hypothetical aspects of artificial intelligence while they impose, from now on, disruptive algorithms of artificial intelligence, without any discussion. Another aspect is some “rhetorical shift”: For instance, we discussed a lot of autonomous vehicles (which obviously will not work after a great craze due to hazardous media ads), and while we waste time discussing “the dangers or benefits of autonomous vehicles” we miss asking the real question “do we need autonomous vehicles or are there other transportation emergencies?”.

already there (even if we do not notice it), what is coming, and what is hypothetical. The better understanding offered by the two previous sections makes really sense here. Some applications are detailed, some others are to be ... invented. The question is also raised about when we do *not* need IA.

A step further, AI initiation of everyone is a key competence regarding what is called 21st century skills<sup>10</sup> as explained in Fig.1 and developed in [12]. With respect to this disruptive technology we need *critical thinking* to make the distinction between beliefs and effective tools, *computational thinking* skills to understand how it works in order to understand what happens when using it, *problem solving* capability to interact with these objects at the application level, *creativity* to develop and create our own usage of AI mechanism (and not only undergo the imposed uses), and *collaboration* because all this can not be managed alone.



**Fig. 1.** A detailed representation of 21st century skills, from <https://margaridaromero.me> with permission.

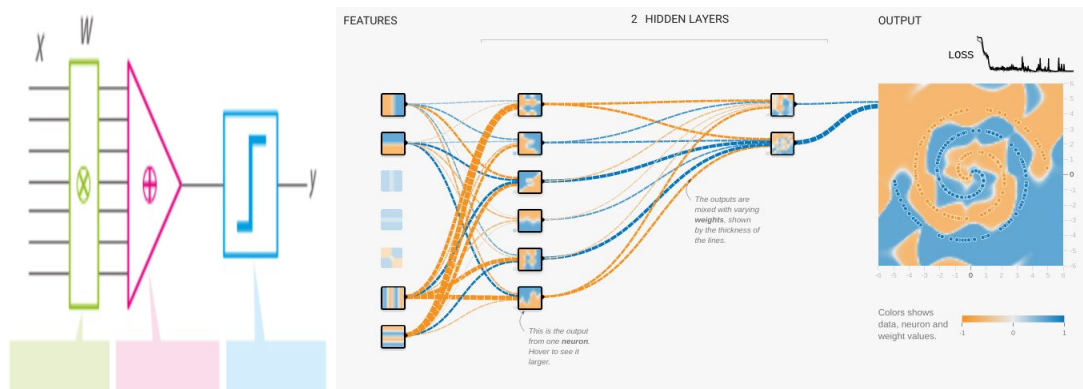
Wondering how a machine would learn to solve such a complex task, comparing natural and artificial intelligence is also a great opportunity to ask how we, humans, could solve “mechanically” a complex task, a very interesting way of thinking in a reflective way how a human brain can solve it systematically. This is in direct link with computational thinking [12], and this aspect is highlighted in the proposed formation.

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The autonomous vehicle already exists: to avoid any risk it is run on specific tracks, to facilitate driving we put guide rails, to save energy we make collective vehicles, they can even drive automatically, it carries a name: it's called a train.

<sup>10</sup> [https://en.wikipedia.org/wiki/21st\\_century\\_skills](https://en.wikipedia.org/wiki/21st_century_skills)

With respect to other offers in the field [1], the contents are less technical (e.g., machine learning programming in Python is proposed only as an extension), but not only a verbal introduction, while effective activities, including unplugged activities (i.e., without a computer using low-tech everyday tools), are proposed to really understand how-it-works. We not only talk about AI, we make people manipulate. As an example, in Fig.2, we summarize the level of technical explanation given for an activity using the <http://playground.tensorflow.org> interface, where participants are invited to build and train their own small deep neural network to solve a categorization task, while other activities with images or sounds are proposed, learning by doing.



**Fig. 2.** The level of technical explanation of the “how-it-works”. Left: An elementary computation (e.g., predicting whether the person head is feminin or masculin) is implemented via a computation unit (i.e., neurons) taking into account several input data  $X$  (e.g., the hair length, face pilosity, mensurations, ...), each up to certain weight  $W$  depending on their pertinence or robustness (e.g., pilosity more than hair length) and combine then before providing an output  $y$ , based on statistical adjustment. Right: Combining many computation units in layers (i.e. deep-network, when many layers), allows to realize complex robust computations (e.g., face recognition or categorization) providing that all information has been “put in numbers” (i.e., quantified), with results that can be interpreted at a semantic level by humans. Images re-edited from <https://pixees.fr> and <https://playground.tensorflow.org>.

#### 4. Learning by doing, activities descriptions.

Each of the three chapters of the course is illustrated by concrete activities that bring learners to train their own machine learning models and interact with real life applications of AI.

For the first part of what artificial intelligence is, participants develop a first understanding of AI through training a visual recognition neural network model. In order to frame the activity, we designed an integrated tool to control the training of the model. This experiment is sequenced in three steps. In the first step the learners create a model that differentiates between two categories of images by feeding the model images from a dataset of samples given to them. This first step helps dispel preconceived ideas we have noticed in children with whom we did this activity such as the idea of an AI is a robot that can recognize anything in an image. They are led to realize that the AI they have trained can not recognize categories it was not trained on by testing it on images that do not represent one of the two categories known to the AI. In the second step the children are brought to understand that with few examples the machine learning model struggles to generalize the concepts represented by the images by testing it on images that matches one of the categories but in a different context or position (a drawing of a lion instead of a photo of a lion for example). The last step is making them train a model on their own dataset with the classes and examples they choose and find.

The second activity around how artificial intelligence is done aims to highlight the central role of data in the making of machine learning applications through experimenting with biases in datasets. We have created a dataset of images with two categories: women and men with an obvious bias (women have long hair and men have short hair). After training a first model with this dataset and seeing it fail, the participants are then invited to reflect on the wrong inferences and create their own dataset to train a better model. They select data, train their model, test and iterate until they're satisfied with the result. Then, to emphasize the importance of data, participants are invited to build datasets to train machine learning models to recognize subjective categories, for example "cute cat vs ugly cat" and

thereby understand the responsibility that fall on the humans creating AI's and the importance of questioning the data behind the AI applications they might encounter.

The last part about the interactions between AI and humans is illustrated by a series of activities where children experiment real life AI applications. They are first exposed to painting generated by a Generative Adversarial Networks model and the painting made by a human painter the model was trained on. They are asked to try to differentiate the human paintings from the AI generated paintings. Then they get to modify the YOLO (You Only Look Once) model to use a camera based real time image recognition model. and finally the add triggers to a chatbot. These activities aim to broaden their understanding of the applications of machine learning and question how they can help humans.

## 5. Method and Production

Contents allow us to gain a first understanding of what AI means and what it is not, understand the principles of machine learning and the crucial role played by data, taking into account the societal issues of AI. Learners are invited to question themselves, beyond preconceived ideas, and really understand the ground of AI; perform activities and manipulate AI programs to build their own vision; acquire a minimal scientific and technical culture (concepts, history of humans and ideas). As an outcome they are able to discuss the subject, question applications, choose some framework to contribute to the development (or not) of AI applications:

- *Questioning*: Deciphering the discourse around AI to move from preconceived ideas to questions on which to rely to understand.
- *Experimenting*: Perform activities and manipulate AI programs to make up our own mind, with both online and unplugged activities [11].
- *Discovering*: share a minimal culture, scientific and technical, to become familiar with concepts through the history of humans and their ideas.
- *Appropriating*: being able to discuss the subject, its applications, its framework with various interlocutors to contribute to the construction of AI applications.

We produced a *hybrid, participative, performative and contaminating* training:

- Freely accessible online training course with free of charge attestation of attendance; online exchange forum, to share and help each other, when training on these subjects; online and in real life hangouts to extend this sharing and serve local projects on these subjects, all content items being also reusable to derive and build other resources.
- Hybrid : Because online resources are designed to derive *in situ* activities. As a consequence, there are no “time limited sessions” but people join when they want and return when they need.
- Participative : In the sense that not only “scientists and engineers” with professional video and content producers have co-created the resources, but also “end-users” such as teachers or parents, while the content is adapted considering the participant feedbacks, including new resources creation (a kind of “wiki” where participants provide their input via forum messages and we take care of the shaping).
- Performative : Because students are taught to be their own teacher, while helping each other, and we also consider “how to learn to learn” mechanisms (e.g., find some answers on the web, discover some elements by themselves during problem solving activities).
- Contaminating : Because students are invited to “pay” this course by ... sharing the contents with people from their surrounding.

Nothing “new” here, just the fact we not only propose a xMOOC “course” but also dedicate enough time resources to discuss with the participants, beg external person to contribute when needed, and do not restrain our participation to “our” MOOC but are willing to export also some resources or dialog into other initiatives of the same kind (e.g., driven by <https://www.reseau-canope.fr> or other <https://classcode.fr> partners), i.e., not only “with us” but also “at the others”, using an approach known as cMooC [16].

This blended formation is hybrid and each chapter is illustrated by activities that bring learners to train their own machine learning models and interact with real life applications of AI, as detailed in the previous section.

The formation is also performative and contaminating in the sense that an adult benefits from this training and then in his family or in his business, association, structure shares what he has discovered with his or her children or the seniors, or the other way round. Part of the training exercises is to be able to transmit what has been learned. Which is also a good way to learn. In Fig.3, we show such an activity that can be redone with family or friends.



**Fig. 3.** Left: This “AI” machine is made of “balls and bowls” (or any equivalent objects) and after training will always win the “nim game”, just putting for each move a red or blue ball, depending on the game issue (win or lose), in the bowl corresponding to each move. After training the whole game policy is stored in the “machine” and the artificial player just has to choose what to play counting the balls in the corresponding bowl. Right: The “Nim game” is a simple strategy game in which two players (here a human and the “machine”) take turns removing (or “nimming”) objects 1, 2 or 3 objects (here rods), the loser making the last nimming. This setup allows us to understand what is an algorithm (including algorithmic recursivity), what is called “reinforcement learning”, why a mechanism can “learn” a non-trivial rule (in fact, “always leaving a multiple of 4 rods”), without understanding anything. Images from <https://pixees.fr> as open CC-BY resources.

Regarding unplug activities, it is often said that we should limit screen time, avoid digital passivity, and develop critical thinking about the digital world. A paradigm exists in which neither hardware nor software are required: unplugged computing (see [11] which has an English version as supplementary material for details). During unplugged or computerless activities<sup>11</sup>, we learn concepts, by playing, approach computational thinking [12] as a way of solving problems, in which computers are not the end in themselves. Unplugged computing activities have the advantage of not requiring costly equipment or the skills to operate it, relieving the cognitive cost to invest to make them work, allowing us to concentrate on the contexts. It is also the best proposal for so-called “contaminating” activities. In artificial intelligence initiation, it has also the major advantage to demystify and unpersonify the machine.

Concretely the resources (as exemplified in Fig.4) are made of short videos freely reusable, synthetical texts, quiz to auto-evaluate what has been shared and also find by yourself some elements, activities online to manipulate machine learning algorithms via graphical interfaces, and unplugged activities to be performed in the family, with friends or in educational contexts (as exemplified in Fig.3); such activities are designed to be also realized by youngsters (typically K6 - K12); last but not list a mind-map, peer-to-peer corrected, is proposed in order to summarize what has been learnt via such a key-word graphical representation. A step further, the forum is an important tool: quiz questions are discussed (some of them have been improved after the first answers), and notions are re-explained or re-formulated, up to the point of enriching the core resources with re-writing of shared information: the goal for this citizen formation is to be improved by citizens.

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<sup>11</sup> During unplug activities, the learners can take a step back, embodying [13] their learning through activities involving movement. It aims to develop a socio-critical approach through which the learner and citizen develops a critical and creative relationship with digital technology, appropriating the concepts and processes of computational thinking with their entire mind and body. The positive impact of these activities was studied, for instance by Brackmann and his colleagues [14] on two classes with a control group; they observed a statistically significant improvement in the children’s performance in computational thinking, for example, breaking down problems into sub-problems.





**Fig. 3.** Two examples of open reusable resources. Left: One thumbnail of the videos, based on a 3 to 4 minutes dialog between Guillaume, who is the “citizen”, and a researcher. She answers the question, gives some explanations, and invites him and us to question, experiment, discover and discuss each topic. Right: An example of the first screen of an interactive animation, guiding step by step to the discovery of a content, and some manipulation. The key point is that these resources are modular in order to be reused in other courses developed by the teachers (in the wide sense) using this resource for their formation. Images from <https://classcode.fr/iai> as open CC-BY resources.

## 6. First results and Analysis

After three months of activity, more than 13000 persons have been engaged in the MOOC (37% female, 62% male, 1% not binary) with more than 1600 persons active (answering to the first quiz) and about 600 persons done yet.

Even if the MOOC massively reaches a French public (79%), the African public is also well represented (Morocco : 4% ; Senegal, Tunisia, Cameroon, Ivory Coast : 1%). In all, 51 countries are represented.

Participants are mainly active (52% on activity, 14% retired, 12% students, 8% job researcher), mostly with university level (62% at least master degree in any field, 10% PhD), but rather beginners in the field (59% full beginners, 38% intermediate non expert).

Working time is 10 to 20 hours on average (about 50% of the people spend from 2 up to 5 hours per week, during about 3 weeks, while 25% spend less and 25% more), and above 94% of people having their expectation satisfied (43% fully satisfied), and 82% of them state that they could recommend this MOOC.

This statistics come from a start-of-course (1140 respondents) and end-of-course (217 respondents) surveys completed anonymously by participants on a voluntary basis. We should note that there is a bias in this survey since it is expected that it is people who are really invested in MOOC, and probably - as a result - the people with the best track record, who responded. This survey was presented as a tool to listen to participants' opinions, get to know them better and improve training over time.

On the forum, more than 500 persons have been or are active while more than 3100 are reading the about 370 discussions, more than half being on the course contents (e.g., strong versus weak AI, symbolic versus numeric methods, societal issues, ...). More than 10 online hangouts of 30 to 200 persons have been organized already by one of the 70 partners of the Class'Code project [4], during this covid-19 confinement. Several pieces of this resource start to be reused to build other resources, e.g., to enrich textbooks<sup>12</sup> and their digital supplementary material.

Detailed evaluation results are given in the paper supplementary material of this paper.

Qualitatively, beyond very nice and encouraging positive feedbacks, through the constant evaluation of the course by the users, we are invited to take several improvements into account: (i) extend the existing formation with more operational tutorials, (ii) manage some technical weakness because we

<sup>12</sup> For instance, one of us is also co-author of a “science” textbook for French K11 and K12, the AI initiation being included in the curriculum of this school teaching.

integrate state of the art recent external resources, some still to be consolidated, (iii) complete the existing contents to better help the learner progression. And we will, since this is a long term open course (probably more than 2 years). We have also a several questions on applications domain of IA (i.e., in education, regarding democracy governance, or disabled assisting tool), which are a bit beyond what we can offer in reasonable time, because each third party domain requires a lot of prerequisites before considering IA related tools. Our idea is to offer “plugins” to other courses, i.e., participate regarding IA issues, the first project already in preparation being on GreenIT. For all these considered extensions, the present course acts as the core curriculum.

A few persons did not find what they expected, either because they are not interested in redoing activities with young people (of any age ;) ) to better understand or because they were looking for professional formation. In fact, we mainly reached rather highly educated persons, while we target popularisation, which seems to be more the case now, but slowly. In both cases, when a person joins, the content is always considered as accessible, and useful (“good to know”). The hard point is thus convincing yourself to join. We hope that in real life hangouts and also community approaches will help, and work on this aspect [5,6].

On our side, we are really delighted to participate on these researcher-citizen exchanges and shares, with very interesting questions, sometimes on crucial subjects, always kind and moderated (no troll<sup>13</sup>, yet ;)).

We also better understand the real educational needs regarding AI foundation and applications. People clearly first want to clarify their belief about such a topic, understand what is true, what is coming and what is putative only. They then want to link such knowledge with concrete applications, e.g., what can be done regarding visual or audio processing, or not. This was easily covered for generic applicative tools, this is less easy to address for specific domain applications (e.g., justice or medicine) because this strongly depends on many other specific aspects of how it can be used. They finally are generally surprised but then highly convinced that they must “play with it” to build their own correct representations, and are rather proud to succeed.

With respect to other studies on MOOC engagement the present success seems to be related, as expected, to the “important role that instructors, course resources and pedagogic practices that focus on providing problem-centric and active learning play in engaging online students” [16] yielding good behavioral, cognitive and affective engagement, even if the didactic objective is specific but rather wide (here “understanding AI” with respect to, e.g., learning a given programming language), while peer interactions were really poor. Further studying this engagement, as performed in, e.g., [16] is a perspective of the present work.

## 7. Conclusion and Perspectives

To conclude, we are proposing a “maker” approach to AI popularization. This offer stands between technical courses allowing the use of AI at work, such as [1], and more superficial presentation of AI only in “words”, as made explicit in sections 2 and section 4. It seems to cover a real need, as quantified in section 6, and our goal is to really multiply the audience, but either within the MOOC itself or by contributing to other initiatives.

This “popular education” initiative is a contribution to the idea of a “*ubiquitary citizen university in digital science and culture*” [3], i.e., the fact that, beyond schooling, our society has a real need of “formation throughout life”. And this is something that must be participative, performative and contaminant, in the sense developed in section 5, contributing to everyone 21st century education in the sense reviewed in section 3, regarding AI competencies and beyond.

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<sup>13</sup> We only got a bitter exchange about the fact we are very strong on gender equality, e.g., using inclusive writing (i.e., expliciting both male and female genders in French writing). Gender equality issues are especially important in the present context, and are omnipresent in our resources. This has been considered as “too much” by one participant, while several did support our choice.

As next steps, we are going to invite a MSc student to deeply analyze the available learning analytics in order to better understand how to pursue (for at least two years) this initiative. We also are going, within the <https://www.cai.community> project, to further work on the online community aspects, targeting teachers (we must make a choice in terms of community), and this will drive us toward not only considering teaching AI, but also teaching AI to teach with AI, including using AI frameworks (both symbolic and numeric) to better model how a learner learns.

And for those who still believe that AI will generate a dystopia or some utopia, we will carry on explaining that this is neither wrong nor true, but a belief (anyone is free to have his or her own belief), and the best way to clarify, see go further, such belief, is to understand intelligently artificial intelligence.

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## Declarations

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*Conflictual or competing interests:* Not applicable for the non-commercial “common good” reported here: This free access resources set is also not, up to our best knowledge, in concurrence with any other equivalent commercial product.

*Availability of data, material and code availability:* All resources are available under CC-BY or CC-BY-NC-SA licences and the platform software is open-source under the CeCILL-C (a French declinaison of the GNU-GPL).

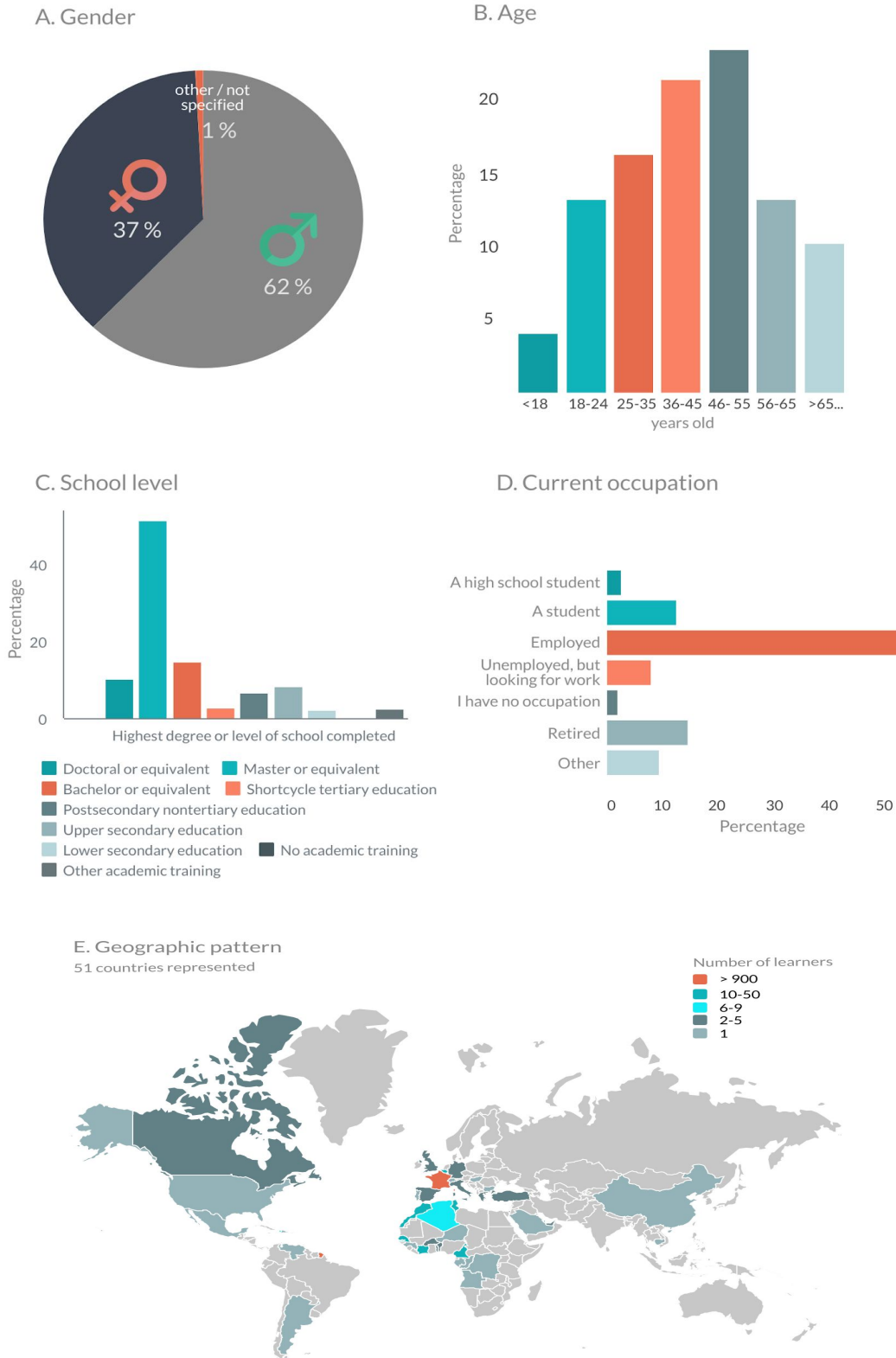
## References

1. A free online introduction to artificial intelligence for non-experts, <https://www.elementsofai.com>, last accessed 2020/05/31
2. Mariais, C., Roche, D., Farhi, L., Barnabé, S., Cruchon, S., de Quatrebarbes, S., Viéville, T. EIAH'19 Wokshop : Apprentissage de la pensée informatique de la maternelle à l'Université : retours d'expériences et passage à l'échelle, Paris, France (2019) <https://hal.inria.fr/hal-02145466v2>
3. Atlan, C., Archambault, J.P., Banus, O., Bardeau, F., Blandeau, A. et al.. Apprentissage de la pensée informatique : de la formation des enseignant·e·s à la formation de tou·te·s les citoyen·ne·s. EIAH'19 Wokshop - Apprentissage de la pensée informatique de la maternelle à l'Université : retours d'expériences et passage à l'échelle, Paris, France (2019) <https://hal.inria.fr/hal-02145480v1>
4. The Class'Code <https://classcode.fr> online reusable formation <https://classcode.fr/iai>, last accessed 2020/05/31
5. Corieri, P., Romero, M., Massart, T., Goletti, O., Mens, K., et al.. Enjeux dans la création d'une communauté d'enseignants engagés dans l'apprentissage de l'informatique. Didapro 8 - DidaSTIC - Colloques francophones de didactique de l'informatique, Lille, France (2020) <https://hal.inria.fr/hal-02426274v1>
6. Romero, M., Lefèvre, S.-C., Viéville, T. When a Master of Sciences on EdTech becomes an International Community. ERCIM News, (2020) <https://hal.inria.fr/hal-02418510v1>
7. Searle, J.-R. Minds, Brains and programs, The Behavioral and Brain Sciences, vol. 3, Cambridge University Press, (1980).
8. Wolpert, D.H., Macready, W.G., "No Free Lunch Theorems for Optimization", IEEE Transactions on Evolutionary Computation 1, 67. (1997)
9. Ganascia, J.G. Le mythe de la Singularité : faut-il craindre l'intelligence artificielle ? Éditions du Seuil, Collection Sciences Ouvertes, (2017)
10. Rougier N. Demystify artificial intelligence: Challenges and history of artificial intelligence, Class'Code popularization video and text (2018) <https://pixees.fr/demystify-artificial-intelligence>
11. Romero, M., Dufлот-Kremer, M., Viéville T.. Le jeu du robot : analyse d'une activité d'informatique débranchée sous la perspective de la cognition incarnée. Review of science, mathematics and ICT education, Laboratory of Didactics of Sciences, Mathematics and ICT, Department of Educational Sciences and Early Childhood Education - University of Patras.
12. Wing, J. M. Computational thinking. IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC), 33. IEEE. (2011).
13. Tsarava, K., Moeller, K., Pinkwart, N., Butz, M., Trautwein, U., & Ninaus, M. Training Computational Thinking: Game-Based Unplugged and Plugged-in Activities in Primary School. European Conference on Games Based Learning, 687–695. (2017).

14. Brackmann, C. P., Román-González, M., Robles, G., Moreno-León, J., Casali, A., & Barone, D. Development of computational thinking skills through unplugged activities in primary school. *Proceedings of the 12th Workshop on Primary and Secondary Computing Education*, 65–72. ACM. (2017).
15. Romero, M. Les compétences pour le XXIe siècle. Usages créatifs du numérique pour l'apprentissage au XXIe siècle, 15-28, Chap2. (2017)
16. Hew, K. F. Promoting engagement in online courses: What strategies can we learn from three highly rated MOOCs. *British Journal of Educational Technology*, 47(2), 320-341. (2016)

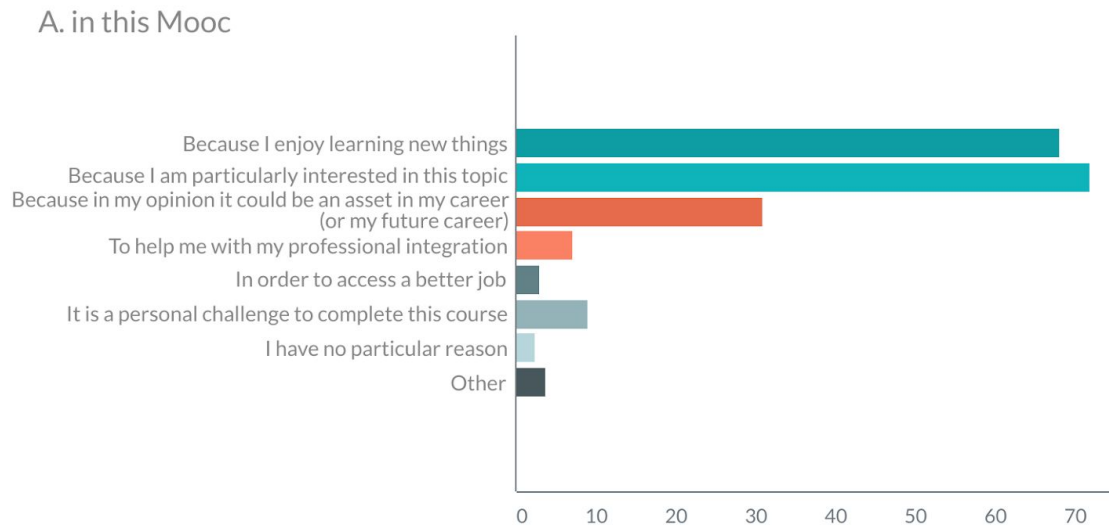
## 8. Supplementary material: details on the evaluation result

### Participant Profile

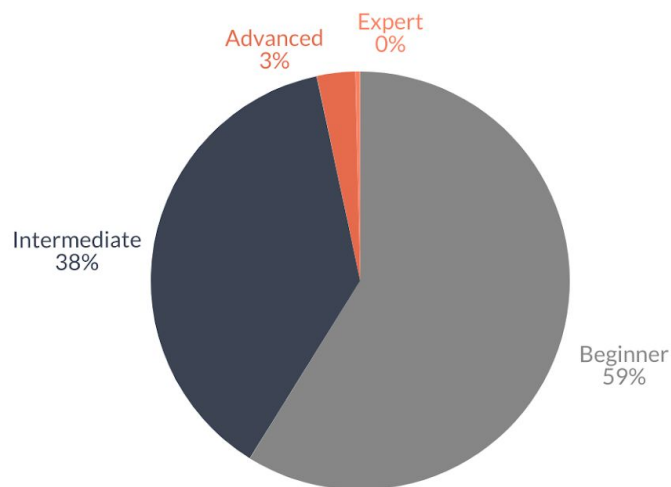


**Fig. 1. Participant Profile.** A. Gender ; B. Age ; C. School Level ; D. Current Occupation ; E. Geographic pattern. *Statistics come from a start-of-course (1140 respondents) survey completed anonymously by participants on a voluntary basis.*

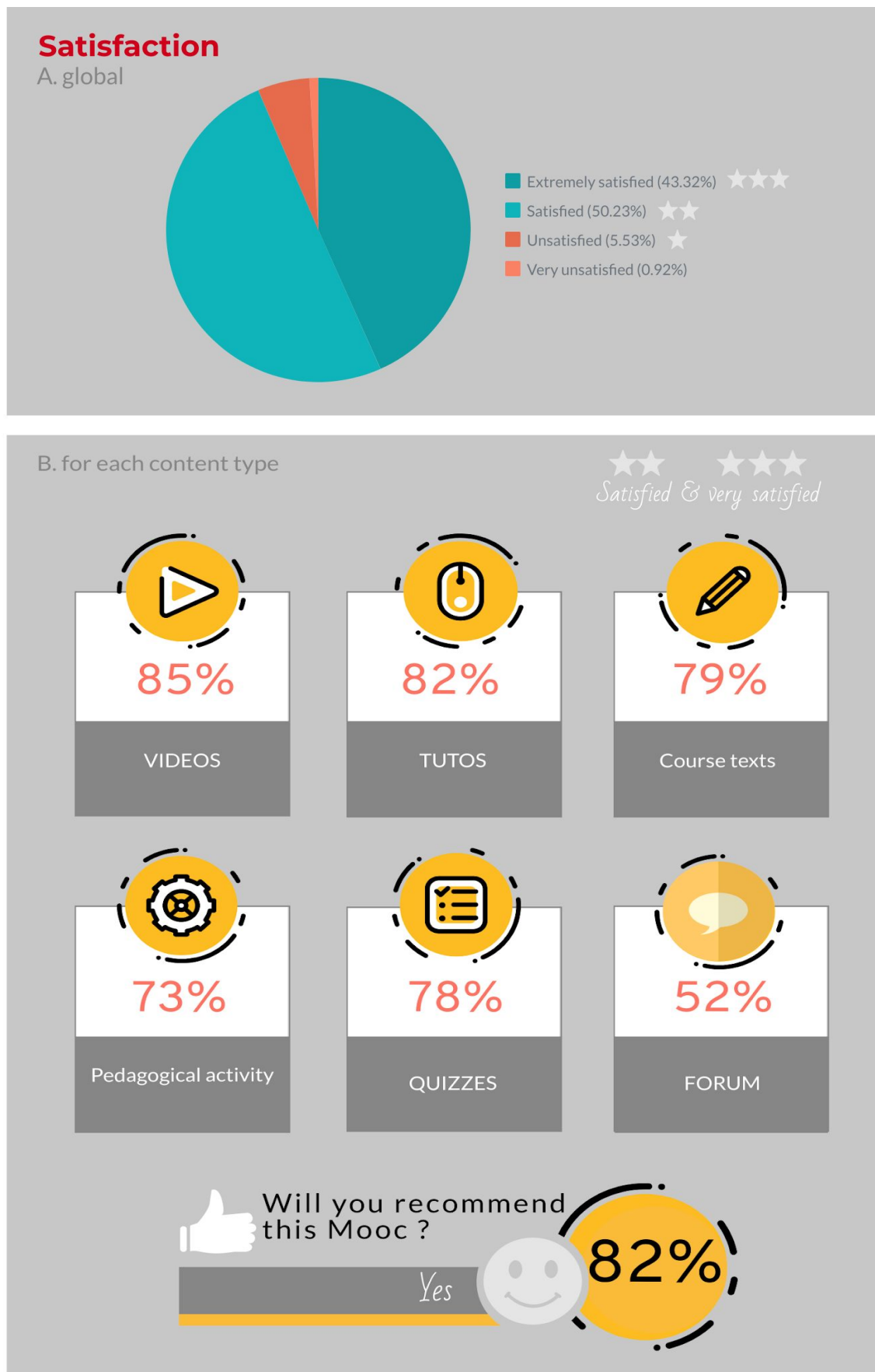
## Interest



B. Knowledge on IA



**Fig. 2. Interest for the MOOC and IA.** A. Interest in the MOOC ; B. Knowledge on IA. *Statistics come from a start-of-course (1140 respondents) survey completed anonymously by participants on a voluntary basis.*



**Fig. 3. Participant Satisfaction.** A. Global ; B. For each content type. *Statistics come from an end-of-course (217 respondents) survey completed anonymously by participants on a voluntary basis.*