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CONVERSATIONAL AGENTS IN THE CLASSROOM

Advances and recommendations

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digital for education"
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Contents

Introduction

Today, new subjects are being introduced in the first cycle of schooling in connection with the new skills to be acquired in the age of artificial intelligence (AI). Whether it is **language learning** in the context of an even more pronounced globalisation, **learning algorithms** and **computer code** to train the next enlightened citizens and producers of technology, or the development of non-technical skills such as **oral expression**, these subjects are fundamental but have also been historically underdeveloped and underdeployed in our education system.

The use of intelligently scaled digital tutors as **conversational agents**, using learning AI or not, can **assist** the teacher in his or her transmission work, and **support** the student in his or her learning. These tutors can become a powerful pedagogical tool that guarantees **inclusive** learning across the territory. At the same time, these intelligent educational tools can also support specialised and personalised teaching for subjects such as **mathematics**, **modern languages**, **life sciences** or **French** in order to optimise educational support by adapting more easily to the level of the pupil. The role of the tutor is to strengthen the link between the student and the teacher and not to replace the teacher, whose pedagogical qualities complement the technical skills of the machine.

The use of these **conversational agents** and more generally of **artificial intelligence in education** raises questions about the relevance and effectiveness of these tools, the impact on the student and the teacher, as well as the collection and processing of pedagogical traces, which are the sometimes personal data of students. This working group is closely interested in these conversational agents in the classroom, both from a technical and pedagogical point of view, as well as in terms of their appropriation by the actors, i.e. pupils and teachers. This study is complemented by the one currently being conducted by the Ministry of Education's ethics committee on the ethical issues of data collected in education.

Conversational agents

Definition and applications

A conversational agent, also known as a *chatbot*, is an agent that dialogues with a user with the aim of doing a search, finding an answer to a question or practising a given discipline. These agents can be **written,** like most of the assistance agents on an online shopping site for example, or **spoken,** like the many voice assistants that are already present in homes such as

The most popular ones are Amazon's "Alexa" or Google home, and on our mobile phones like "Siri". According to a 2018 study[1] , 81% of French people know at least one voice assistant, 61% use them occasionally, and 19% regularly. These numbers depend strongly on the age group. Domestic uses mainly concern internet searches.

These agents are usually designed so that the user ignores the presence of the technology and focuses on its primary functionality, such as research or exercise. It should be noted that this abstraction can be confusing and can even affect the integrity of the user in creating a spontaneous feeling towards the machine. This is called the ELIZA effect. ELIZA is the name given to the first written chatbot in English, developed by Joseph Weizenbaum and his team in 1965 at the Massachusetts Institute of Technology. This agent conversed with patients in therapy, repeating the patients' statements in the form of a question (to the statement "younger I did not get along with my brother", the agent wrote "younger, you did not get along with you brother? ELIZA also regularly intervened with the phrase "I understand". Both of these practices created a sense in patients that they were actually talking to a human because of the apparent empathy of the machine. The ELIZA effect can be as much about combating isolation as it is about directing people for commercial purposes.

These conversational agents are first of all software and computer code. They can be accompanied by a possibly anthropomorphic robotic system. Here again, the ELIZA effect may come into play. In this note, we are mainly interested in algorithmic systems. There are still many technological and scientific challenges in the recognition and semantic analysis of textual or audio exchanges, or in the personalisation of exchanges based on algorithmic learning models. In order to work efficiently, these models need learning data about the student in question, which in many cases is personal data.

In education, mainly written conversational agents are being explored and experimented with. Some of these tools are already used in the classroom. In theory, these agents make it possible to personalise learning by following the child's rhythm, to take into account certain handicaps in the pupil in order to build an inclusive education, or to support the teacher in teaching new subjects or subjects that require a high level of interaction with the pupil, such as modern languages. Finally, these agents can be a pedagogical vehicle for learning while having fun.

[1] Barometer 2018 by My Media on the use of connected voice assistants in France.

Artificial intelligence, algorithms and data

Artificial intelligence is both a method of calculation and a discipline. It includes all the models and algorithms that simulate a phenomenon or a scenario in reality by means of a computer calculation. Launched in the middle of the 20th century, and initially mathematised explicitly, it also became implicit through the improvement of machine learning techniques such as learning from neural networks. Today, a distinction is made between so-called explicit AI, also called "expert systems", and machine *learning*. Explicit AI can be based on decision trees with explicit conditions, or on sometimes complex mathematical models.
For many people, the word artificial intelligence often refers to robots, and other more or less human-shaped machines. Science fiction stories in films, series and novels help to shape our understanding of AI. Robotics is a discipline of artificial intelligence that includes both the construction of computer systems embedded in a mechanical system, and work on human-machine interaction, for example. We are only interested here in the software and algorithmic part of conversational agents. That being said, we are interested in human-machine interactions through written or oral exchanges, and not "physically" with the conversational agent.

AIs have one or more numerical algorithms that are the computer representation of the problem solution. Like AI, a distinction is made between explicit algorithms (in explicit AI) and implicit algorithms (in implicit AI). These algorithms are calibrated and/or trained on data. Among the data, a distinction is made between unstructured data and structured data. Unstructured data are raw data, which are not mathematically or logically structured, or labelled for example. Unstructured data are photos, soundtracks, e-mails or PDFs. Structured data is described by a set of metadata. An e-mail becomes structured data when metadata such as the name of the sender, the name of the receiver, the date sent or the sentiment (neutral, positive or negative) of the body of the text is associated with the e-mail data. An image can be described mathematically as a two-dimensional matrix with each component of the matrix being the RGB value of a pixel in the image. The label of the data contains the result of the scenario on which the algorithm is trained. For example, in the case of an algorithm identifying a dog in a photo, the training dataset contains photos with the label "false" (no dog) or "true" (presence of a dog in the photo).

Algorithms are trained on structured and labelled data, this is called supervised learning. Unsupervised techniques, i.e. on unlabelled data, are also carried out, as in the case of statistical learning for example. It is likely that in future generations of algorithms, the applications of unsupervised learning techniques will be extended. These improvements

will be important as they will allow to get rid of the labelling which can be very time consuming. That being said, the level of explicability of the algorithm, i.e. the ability to explain its underlying logic, will certainly be reduced.

The coexistence of the two types of AI, explicit and implicit, is often fundamental to tackle problems whose mechanisms we seek to understand in order to find a solution, as stated by implicit AI scientists at the 2019 NeurIPS conference[2] in Canada. Through a minimal explicitation of the phenomena, one can understand the mechanisms of the studied phenomenon and increase the level of explicability of the model, and through the implicit component one can go further in the abstraction of the phenomenon to be simulated. The combination of the two will be a challenge in the coming years.

Work of WG6

WG6 mission

The mission of this working group is to feed the Minister's reflection on AI-related issues, but also and above all to propose concrete actions to make France a **world model in education in the AI era**. France has a privileged position (education issues defined at the national level unlike the USA for example) which allows it to act more easily and efficiently at the national level to allow experimentations, studies and large scale implementations. To optimise the effectiveness of their actions, the members of WG6 work in a **pragmatic** and **concrete way**.

Composition of WG6

APPENDIX 1 presents the composition of the GT6 working group. It is made up of members from the Ministry and in particular from Réseau Canopé and the DNE, engineers and researchers in artificial intelligence, some working in the field of education. 13 members make up the WG6, of which 11 are active members and 2 are observers.

Questions and points to be addressed

Among the questions and points that are addressed by the working group:

- How can these tutors further assist the student in his or her learning and development? evolution,
- How these tutors can assist the teacher in his work,
- This is something that the tutor will never do and for which the teacher is fundamental,
- What the tutor can do that the teacher cannot,
- What students may perceive about the use of a tutor,
- What teachers may perceive about the use of a tutor,
- What parents may perceive about the use of a tutor in the classroom,

[2] https://nips.cc/

Working methodology

Comparison with foreign countries to open up

The members of WG6 studied and analysed what is being done and what has been done abroad, specifying what has worked and what has not. They also studied the causes (cultural or otherwise) of the results obtained, as well as the possibility of transferring and scaling up these solutions in the French school system.

Experimentation for better and faster progress

The members of WG6 proposed ideas to facilitate experiments on samples of different sizes (number of schools, number of classes and their territorial distribution) on concrete solutions motivated by comparative studies (with foreign countries and possibly tests already carried out in France), and by means made available to schools and the Ministry.

Concrete solutions for building

Particular attention was paid to the **applicability** and **scaling up** of ideas and solutions to enable a **solid construction of the** set of recommendations for the Minister.

Hearings of researchers and experts in the field of educational AI

Method

WG6 heard from a dozen researchers and experts in the field of AI in education. The people interviewed came from France, Sweden, the United Kingdom and the United States. The aim of these hearings is not to draw up statistics on what is being done in the field of research and development of voice assistants in the educational environment, but to enlighten WG6 on its bibliographic research and the areas to be explored. **APPENDIX 2** lists the people who were interviewed by telephone or by questionnaire. **APPENDIX 3** presents the questions on the form.

Results

1. The work of the hearings

The interviewees have all, in one way or another, developed AI tools for education. They have mainly worked on written conversational agents for learning mathematics, other sciences (physics, biology and earth sciences) and logical reasoning. One team is interested in tools for monitoring student behaviour (tracking eye movement and facial expressions) to obtain feedback on student learning. Most of the tools contain implicit learning algorithms. Among the tools developed by the auditionees are Blender Bot, Betty's Brain, C2STEM, MATHia, ASSISTments,

2. Input from agents

All the interviewees recognised the complementary nature of the intelligent assistant, which will never replace the teacher. One interviewee underlined the possible obsolescence of the assistant in certain subjects such as logical reasoning, once the student has understood how to reason. Finally, cognitive sciences, combined with explicit and learning algorithms, can bring a lot to the development of future conversational agents.

3. The relationship of teachers, parents and students to staff

Once the technology is adopted, teachers and students enjoy using the agent. That being said, in the studies conducted by the interviewees, there are fears and a lack of knowledge of these tools that hinder the arrival of an experiment in the classroom. Teachers are afraid of being replaced. The lack of computer skills among some teachers is also a brake. There is a general lack of confidence in the use of teachers' and pupils' data.

4. The differences between countries

The United States and China are the two most innovative countries in these AI technologies. Advanced technologies are being developed in the United States but experimentation remains very localised, with deployments also localised, due to the decentralisation of national education. There is also the risk of seeing AI technology as the solution to all educational problems in some American schools, and we must avoid falling into a certain technological "solutionism".

5. Additional points

In general, people have a distorted view of technology, mistakenly referring to humanoid robots when it comes to intelligent assistants in education. AI technologies can help students with disabilities, or severe learning difficulties. In this respect, we need to think and build these technologies to make them inclusive. These technologies have a huge potential to measure and change teachers' perceptions of students, and students' perceptions of themselves, but we must be careful not to fall into a surveillance organisation in the classroom. Students, teachers and their personal data must be protected.

Hearings of teachers, pupils and parents

In its newsletter n°5 for teachers, Réseau Canopé (2019)[3] describes the advantages of AI to strengthen educational systems and achieve the hoped-for capacitive complementarity mentioned by C. Villani (Villani, 2018), Réseau Canopé notes that "some teachers have been relying on data analysis for several years now to adapt their teaching (mainly in higher education)". Taking Labarthe & Luengo (2016) as an example, the operator shows that the analysis of learning traces (learning analytics), combined with AI to create adaptive learning, is already anchored in certain professional practices. Yet how many teachers, parents or pupils know about it?
In the light of this and many other examples, it is important to consider the perceptions of what is possible in relation to technical reality.

In this respect, Réseau Canopé organised two years in a row (2019 and 2020) an educational hackathon, the Créathon[4] , one of the objectives of which was to bring out ideas/projects for IT developments or services for AI to serve a more inclusive school. In total, more than 1,000 participants, who during the two 24-hour editions, were accompanied, informed about the challenges of AI and in particular its contribution to education, and how it can contribute to a better education with a focus on inclusion.
Through the information collected during this competition, Réseau Canopé was able to question the representations of what AI can or cannot bring to education, and drew some conclusions:

- Respect for data. The participants indicate this as a potential obstacle to the success of development projects using AI: the collection and processing of this data seems to be an invariant.
- The role of AI in education: in the projects, the AIs imagined could recommend (by allowing the adaptation of contents and/or learning modalities), evaluate (by helping the teacher in the evaluation process of the acquisition of skills) and generate new resources from pre-existing data.

The limitations highlighted by Créathons participants regarding efficient AI in education are numerous and underline the limits of digital accessibility. The cost of the equipment, the lack of user expertise, resistance to change, fear of data misuse, breaches of confidentiality and problems of accessibility and illiteracy are recurrent (Réseau Canopé, 2019b)[5] .

[3] Available at the following URL: https://www.reseau-canope.co.uk/fileadmin/user_upload/Projects/agency_of_use/6855_BulletinVeille_5ia.pdf

[4] To find out more about the Creathon, a presentation of the event, the methodology deployed and of the objectives are available in the trend books.

[5] The trend books for these two editions are available at the following URL: https://www.reseau-canope.fr/agence-des-usages/dossiers-thematiques_intelligence-artificial.html#anchor-content

Given the few results on an acculturated population, it seemed important to continue to investigate the representations that the educational community has on the place of AI in education.

Since then, WG6 has interviewed nearly 1000 people, including **teachers**, secondary school **students and parents**. The form focuses on representations of the role of the AI in education. The analysis of the results should allow a better understanding of the hopes and fears placed in the AI in order to build a better mediation, and to make relevant proposals according to the profiles of the public (teachers, students or parents). **APPENDIX 4** presents the questions of the form. Question 3 deals with both positive and negative perceptions of artificial intelligence, and the suggested answers depend on the type of profile of the respondent (teacher, student or parent).

For years, the collective imagination has been nourished by information, knowledge, stories, practices, beliefs and fears about technologies that should create an increasingly close link between man and machine. All these ideas function as social markers that serve to name and define everyday reality and give meaning to these practices (Abric, 2001; Jodelet, 1993). Identifying the representations of technology makes it possible to understand the elements that come into play in the logic of appropriation of technology (Flichy, 2001; Le Marec, 2001; Chambat, 1994; Jouët, 1993; de Certeau, 1990). What representation of artificial intelligence in education do the actors of education construct for themselves? Among other things, the preliminary results presented in this document give some clues as to the brakes and levers that these actors observe for the introduction and/or generalisation of AI in education.

Methodology

The Digital Working Group on Artificial Intelligence (DWG AI) has proposed an online questionnaire to education stakeholders to find out how they see artificial intelligence in education.

The questionnaire consists of four parts:

1. Respondent profile.

The role of the respondent in completing the questionnaire (e.g. parent or teacher) and the department of practice or study were asked of all respondents. Some information was collected specifically for certain profiles:

- For students, age was also asked.
- For adults (parents and education officials), seniority in their jobs and digital fluency were in addition requested.

- For national education officers, clarification of their function was requested.

2. **Hierarchical evocation.**

In answering the question "When you hear the word 'artificial intelligence in education', what words or phrases come to mind?", respondents were asked to list 5 words or phrases in order of importance (the first being the most important).

3. **Classification of assertions**.

A list of 14 statements regarding the use of AI in education was proposed. Half of the statements focused on the possible disadvantages of AI in education while the other half focused on the possible advantages. To validate their answer, respondents had to rank at least 4 of the proposed statements.

4. **Open questions for teachers**.

In addition to the questions listed below, teachers were asked to:

- List the educational services based on artificial intelligence that they used or knew about ;
- Indicate whether or not they wish to participate in group interviews on the subject of the questionnaire;
- Indicate whether or not they wish to participate in a test panel of users;
- Leave any comments in general.

Results

1. Assertions: all actors

After 6 weeks of testing (end of January to mid-March 2021), 1321 responses were collected. Of these, **928 responses** with at least three words in the hierarchical evocation section or at least four ranked assertions were selected as the analysis sample. As shown in **FIGURE 1** (in the appendix), more than half of the sample (57%; 527 responses) is made up of responses from teachers and educational figures who accompany pupils in schools (CPE, AED/AESH, nurse, psychologist, etc.). Next, the parents of the pupils represent 19% (176 responses) of the usable responses. The inspectorate (IA-PR, IEN, EG/ET) and management staff accounted for 10% (95 responses), while each of the groups of students and pedagogical agents from the Ministry of National Education, Youth and Sports (DNE staff, Réseau Canopé or CNED agent, digital referent) represented around 7% (66 and 64 responses) of the sample.

Overall, in this study, adult respondents with between 11 and 30 years of work experience are more represented, as shown in **FIGURE 2** (in annex). As for the geographical distribution of all respondents (**FIGURE 3** in the appendix), Martinique, Ville de Paris, Val-de-Marne, Doubs, Loire-Atlantique, Hérault and Guadeloupe are the departments that contributed most to the responses in this study. Depending on their profiles, the origin of the responses varies:

- **Educational agent of the MENJS**: Martinique, Paris and Vienne
- **Teachers and teaching assistants**: Martinique, Hérault, Paris
- **Inspectorate and management staff**: Martinique and Guadeloupe
- **Students** : Val-de-Marne, Doubs, Paris
- **Parents**: Paris, Val-de-Marne and Loire-Atlantique

Overall, the adult respondents in this study report feeling comfortable with digital technology (**FIGURE 4** in the Appendix). However, when the response scale is converted to binary data, parents of students report being slightly more comfortable (88%) in using digital technology than teachers and teaching assistants (84%).

According to the central core theory (Abric, 2001) of social representations, the elements of the representations can be organised in four quadrants, according to their average rank and their average frequency (**APPENDIX 5**). The analysis of the proposed assertions shows that the elements that are anchored in the social representation of AI in education by all respondents are positive:

- The AI could provide students and teachers with educational resources customised (+) ;
- The AI could facilitate educational differentiation by offering pathways and personalized follow-up (+) ;
- AI could help to reduce dropout by identifying early difficulties of pupils (+) ;
- AI could facilitate the dynamic creation of student groups based on their needs and profile (+) ;
- AI could allow students to practice without fear of being judged (+).

These results address two dimensions in particular: helping teachers to implement educational differentiation (by proposing resources and pathways, by fine-tuning pupils and by creating need groups) and enabling pupils to learn and gain confidence without social pressure.

According to the core theory, the elements of the first periphery can potentially modify the representation of AI in education (Abric, 2001). In the sample analysed this corresponds to the topics of increasing the amount of time students spend on screens (-) and reducing the administrative burden on teachers (+).

According to the χ^2 test, the dependence between the first four rankings of the assertions and the profiles of the respondents (**APPENDIX 6**) shows that the representation of teachers of AI in education is composed first of all of disadvantages, in particular concerning the use of screens and the disparities between pupils. On the contrary, the pedagogical agents of the MENJS and the inspection bodies have a representation focused on the contribution of AI to pedagogical differentiation, student practice and the reduction of the administrative burden on teachers.

As for parents and pupils, the representation of AI in education remains mixed. Parents are very concerned about the reduction in the diversity of children's interests and the increase in screen time. This, while observing the possibilities and benefits of educational differentiation. Pupils, on the other hand, are concerned about the presence of teachers both to monitor their learning and for their pedagogical freedom. Pupils also see the reduction of the administrative burden on teachers as a benefit.

2. Hierarchical evocation: focus on teachers

Of the 527 teachers in schools who responded to the questionnaire, 466 completed the hierarchical evocation test. 82% of them are secondary school teachers, while 12% are primary school teachers and 6% are figures who accompany pupils in schools. The majority (85%) of teachers say they feel relatively comfortable or completely comfortable with the use of digital technology. It is therefore up to us to analyse the following results in the light of these statements.

The corpus analysed consists of 2,163 words or expressions, i.e. an average of 4.64 associations per respondent. The categorical analysis was carried out with 195 different words or expressions. The minimum frequency was determined from the words cited more than 10 times, which constitutes 82% of the total corpus collected. Based on the calculation of the average rank (2.9) and the average frequency (7.8%) of all categories, the first 30 most cited words or expressions were distributed in four quadrants, following the central core theory.

The results (**APPENDIX 7**) show that, for teachers, the elements that are embedded in the social representation (core) of AI in education are the following

- The **need for digital equipment** that exists for AI to be used. This category includes words or phrases that connote hardware, connected objects, but also issues of connectivity and the budgetary means needed to acquire such equipment.
- The **programming** required in AI development. Coding, software, programming languages and computer literacy in general are words associated with this category.
- **Algorithm** is a category that refers to calculations, statistics and the probability related to the creation of algorithms for artificial intelligence.

- The possibility that AI offers to put into practice **pedagogical differentiation.** AI would allow for the adaptation of learning pathways and learning to the levels and rhythms of the students as well as support for students with special needs.
- The presence of **digital technology in** general: from the digital dematerialisation of documents and objects to the use of digital technologies and the culture of these uses.
- **Technology** here is seen as 'advanced', 'new' and sometimes 'innovative'.
- The act of **learning**, developing skills and cognitive abilities.
- **Automation** of tasks, administration of exercises, corrections and systems.
- Finally, the **robot,** an element that evokes the possibility of the presence of robots in the educational context as actors: "prof-robot" or "robotization of students "and as an auxiliary tool: "chatbot" or "bot". Given the words in the same category, we can hypothesise that the meaning of robot is more related to the robot as presented in science fiction than to the use of chat bots.

The elements that can potentially change the representation of AI are those of the first periphery :

- **Help/assistance:** an element that refers to the possibility of receiving help, advice, information for decision making. It also refers to AI as complementary aids to school learning, especially facilitating tasks.
- **Performance:** AI could contribute to the effectiveness and efficiency of the delivery of certain tasks.
- **Data analysis and processing:** AI would involve observing the quality of data, its storage, processing and analysis.
- **Future:** AI represents the future, the future, the education of tomorrow.
- **Evolution:** it represents modernity, a "new world", even progress inevitable.
- **Dehumanising:** AI would risk dehumanising the educational act, making it impersonal, insensitive, implying greater solitude for the various actors.

It is worth mentioning that among the 30 most quoted words or expressions, 7 categories of words with an explicitly negative or positive connotation can be identified. Without taking into account the ranking, the occurrence of "negative" words (155) is eight times more numerous than words in the "positive" category (19). Thus, 33% of respondents cited a word from the 'negative' grouping at least once. This grouping of categories alludes to a distrust (35) of this technology, perhaps related to the fact that it is still seen as opaque and confusing (16) to respondents. Similarly, this grouping raises an unreal and illusory side (31) of the potential of AI i n education. There is also a distrust (35) of the use of data,

the possible 'robotisation' of the school, which is worrying (28), dangerous (25) or not necessary (20). On the 'positive' side, the category 'stimulating' (19) refers to the attractiveness that using such technology would bring to students.

A detailed analysis of the words or expressions evoked needs to be carried out. However, we can already identify the categories of words or expressions that were frequently ranked first (in decreasing order): "robot", "need for equipment", "programming "differentiation/personalisation", "digital", "help/assistance", "algorithm "We offer a preliminary analysis here.

The question of the mention of "robot" raises two issues. It questions a possible representation of a mix between AI for education and educational robotics. It is therefore necessary to make it clear that the two are not intimately linked as might be thought, but that both can provide pedagogically interesting complements in an educational dimension (e.g. use of robotics to learn about algorithms before moving on to AI). This should also raise questions about the fear often expressed of the robotisation of teaching, which, in representations that have endured and are often fuelled by science fiction, would replace the teacher. We must therefore identify these fears and understand them in order to show that AI can be an asset for certain tasks and free up time for activities that only the teacher can accomplish.

The "need for equipment" and "help/assistance" clearly show that the teaching public is ready to take up tools using AI provided that they are sufficiently experienced before using it in their practice with their pupils. The call is twofold: a call for training to enable them to be sufficiently comfortable and a call for technical and equipment support.

Finally, the other categories mentioned should guide us in the acceptability of AI in education: it should allow the personalisation of learning, and should also be a tool for teachers to approach programming and algorithms.

Limits

Given the self-reported "digital fluency" of adult respondents and the medium of dissemination of the questionnaire, it is important to consider the possibility of the "heroic" profile of respondents. Indeed, particularly with regard to teachers and parents, many studies show that those who respond to this type of survey are generally those who are already more comfortable with digital technology, more open to educational experiences outside the traditional format and more participative. This suggests that these results should be taken with caution and not generalised to the whole population of teachers and teaching assistants or parents. Similarly, given that the sample of students is very small, the results of this profile should also be read with caution.

Preliminary conclusions

The representation that all educational actors have of AI in education is rather positive and very much linked to the possibilities of implementing pedagogical differentiation. Nevertheless, if we look at the profiles, inspectors and MENJS agents are more positive about the advantages of AI in education than the rest of the actors. This suggests that the degrees of acceptability are lower among teachers, and that teacher training should take this parameter into account. On the side of parents, teachers and pupils, despite the positive opinion on the pedagogical differentiation that AI could bring, there is still the concern linked to the time pupils spend in front of the screen, to the possible lack of support from teachers and to the accentuation of the disparities between pupils in front of or because of this technology. This therefore represents a twofold challenge: to accompany the apprehension of teachers but also to train them to accompany the apprehension of pupils and their parents.

As far as teachers are concerned, they associate AI in education with the need for material resources, the elements needed to create AI (algorithms, programming) and the use of digital technologies in cultural practices. For teachers, AI can help in the development of skills and knowledge, especially as a tool to implement educational differentiation. It can also contribute to the automation of certain tasks, perhaps through the use of robots. Despite these advantages, there is a reluctance to welcome AI practices in education. "Dehumanising" and "performance" are two elements that could change the representation of AI in education. If AI proves its usefulness and performance in the field, it will still be necessary to accompany teachers so that they find their place in configurations integrating AI in learning and think with them about possible changes in their pedagogical practices.

In view of the possible rapidly changing technological contributions, it also seems very important to renew this type of action with the educational community. This would also make it possible to measure the contribution of the mediation and training recommended in the "Recommendations and prospects" section.

Due to the low number of responses from students, we will reopen the questionnaire at the beginning of the school year to get more responses to analyse. The results can be used by other teams in the Ministry or in other working groups of the CSEN.

The state of the art

Conversational assistance

As conversation is at the heart of the digital experience, it is a key issue in digital transformations. The covid crisis has accelerated the demand for chatbots. Conversational agents have been a way of dealing with the increased volume of exchanges with users. Users are now used to more services than a simple FAQ bot. Development cycles are shorter with a lower cost of entry. Data-driven agents that learn and grow over time are increasingly deployable and essential for good user interaction.

Well-designed conversation interfaces are promising: for example, the HelloVote interface[6] , which allows people to register and vote, is much more user-friendly than navigating through several government sites. It creates more engagement and success (60% registrations compared to 40% with the traditional method). Users have become accustomed to adopting new applications quickly. But conversational interfaces to guide a user through a task seem more natural than applications, more directive[7] . Users prefer voice to text when it comes to getting quick answers. AI platforms such as IBM Watson have dramatically reduced the cost of entry to use these tools.

Today, conversational agents can be found in many fields such as medicine, online commerce, retail banking, emergency assistance and education.

Advances and challenges in conversational assistance

In 2016, Business Insider predicted that 80% of companies would be using conversational agents by 2020[8] . Since then, many of the millions of solutions deployed for different uses (performing specific tasks, collaboration, open dialogue, entertainment) have been abandoned. Many technical and semantic challenges remain to be overcome in order to make these tools true digital assistants capable of interacting effectively with users.

The challenge of descriptive documentation of the solution

The understanding of the mechanisms that influence the user experience in the design of a conversational agent solution is still limited. For example, the perception of counselling chatbots varies radically depending on the solutions proposed:

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[6] https://www.hello.vote/

[7] Chatbots 101. Forrester study by Peter Wannemacher, 2016

8 https://www.businessinsider.com/80-of-businesses-want-chatbots-by-2020-2016-12?IR=T

the *Woebot* tool developed by a Stanford University researcher[9] , which borrows the methodology of cognitive behavioural theory, is receiving an encouraging response. In contrast, the chatbot *Kuki* (formerly *Mitsuku*) offers a disappointing experience[10] . A recent Stanford study shows that user expectations are aligned with the description and documentation of the conversational agent: two different descriptions of the same conversational agent solution imply different user experience feelings[11] .

The challenges of text-based conversational agents

1. The quality of the text generator

This aspect is decisive for the final result: answers that are too short are perceived as boring or showing a lack of interest, and answers that are too long are perceived as a lack of listening by the conversational agent (Roller *et al.* , 2020). There are different choices of bot architecture: those that generate responses by selecting the relevant response from a fixed set of candidate responses (retriever), those that generate text (seq2seq), or a combination of both to overcome the problems of generative models that may be repetitive or unsuitable for learning new knowledge over time.

2. The length of the response

In generative models, decoders and response length are particularly important. A minimum length can be set or the length of the response can be predicted from human-human dialogue data. The training process is often done by pre-training on a large volume of data and then refining on use case data that is usually available in smaller volumes. The dialogue data that is available in large quantities must nevertheless be chosen carefully to anticipate problems of gender bias, discrimination, etc. Ways to reduce these biases by choosing to generate more neutral words are described in a study (Dinan *et.al.* , 2019) by Facebook Research and LORIA (Laboratoire Lorrain d'informatique et d'application).

3. Measure the degree of empathy needed and adapt the response

Building datasets to measure the degree of empathy or relevance of a conversational agent solution is crucial. Datasets exist but

[9] https://www.businessinsider.fr/une-chercheuse-de-stanford-a-invente-une-nouvelle-facon-de-cure-depression-and-you-can-try-it-new-tool-now-34179

[10] http://governance40.com/wp-content/uploads/2018/12/Luciano-Floridi-The-Fourth-Revolution_-How-the-infosphere-is-reshaping-human-reality-2014-Oxford-University-Press.pdf p135

[11] https://hai.stanford.edu/news/how-build-likable-chatbot?utm_source=twitter&utm_medium=social&utm_content=Stanford%20HAI_twitter_StanfordHAI_202105051200_sf143182723&utm_campaign=&sf143182723=1

Their relevance to the use case depends on the application domain (Rashkin *et al.* , 2019 - Prabhumoye *et al.* , 2020).

4. Understanding the type of user and the user's request

Recent advances in natural language processing (NLP) are determining the state of the art of understanding of open dialogue systems, text generation or information retrieval. Systems based on very specific tasks can make more use of pre-determined rules (HUANG et al., 2020).

5. Information retrieval through hybrid methods

Information retrieval methods based on a repository of human-human conversations are smooth, grammatical and of high quality. However, having a sufficient volume of data (scaling the database) is essential for the success of these methods, which are often not very successful for open domain dialogue systems. On the other hand, methods based on natural answer generation (producing new text through a generative model) can produce new answers, but they often generate unwanted answers that are grammatically incorrect or irrelevant. Hybrid methods combine the strengths of both and usually adopt a two-stage procedure. First retrieving information from a database, then using these predefined answers to generate the final unedited answer text through a generative model.

The challenges of conversational voice agents[12]

Conversational agents must be able to be cut off when they are not precise or direct enough, and must be able to react in real time more quickly than text-based agents that send a message and then wait for a response. The voice chatbot also cannot abruptly interrupt itself as humans would probably not react in this way. On the other hand, in order to process the response using text-based techniques, it is necessary to have *Speech-to-Text* solutions that are robust to noise, specific vocabularies and lexicons (Education, Finance, Health, etc.) and different accents or voice intonations. The latency is therefore potentially greater during the time it takes to analyse the request, produce the response and then produce the sound track of the response (Text-to-speech).

Several teams are currently working on conversational agent solutions:

- The team and the open source community of the **RASA project**[13] make it one of the most dynamic solutions in the world (10 million downloads) used by startups as well as large groups. They can thus quickly benefit from

[12] https://agara.ai/conversational-ai-blog/technology/voicebot-asr-chatbot-tts/

[13] https://rasa.com/mission/

innovation through the efforts of the open source community that develops the platform.

- Facebook's *Blender* (open source) *chatbot* solution for open dialogue[14]
- A self-diagnosis chatbot at COVID-19 from the startup Clevy[15] in partnership with the Pasteur Institute with whom they co-created the algorithm. The research institute will benefit from the anonymised data to analyse the statistical results.
- The Stanford AI Lab. team, led by Christopher Manning[16] , which placed second in Amazon's open dialogue challenge (Alexa Prize[17])
- Amelia Hardy's open source project called *Chirpy*[18] which has already interacted with hundreds of thousands of users.

Advances in conversational assistance for education

Conversational agents exist in education (Kerlyl, Hall, and Bull 2006) under various names:

- chatbots,
- conversational agents,
- dialogue tutors.

Early developments based on symbolic artificial intelligence date back to 1982 (Barr and Feigenbaum 1982) according to Bruillard (1997). There is a lot of work in the Building Educational Applications (BEA) automatic language processing (ALP) community at NAACL (North American Chapter of the Association for Computational Linguistics).

In education, automatic language processing is mainly used to automatically correct learners' textual responses (Leacock and Chodorow 2003; Ndukwe, Daniel, and Amadi 2019), resisting typos. A conversational agent can be used by a learner to obtain information from a database, by understanding the query made by the learner in natural language (Colace *et al.* , 2018). There are also conversational agents for the teacher to give feedback on their learning (Datta *et al.* , 2021). When interested in creating a dialogue, one challenge is to generate questions that not only remain in context, but also encourage expression and stimulate learning (Becker et *al.* , 2012).

[14] https://parl.ai/projects/recipes/

[15] https://start.lesechos.fr/innovations-startups/tech-futur/la-startup-clevy-lance-le-covidbot-un-chatbot-dautodiagnostic-au-covid-19-1190648

[16] https://hai.stanford.edu/news/how-create-better-chatbot-conversations

[17] https://developer.amazon.com/alexaprize/

[18] https://stanfordnlp.github.io/chirpycardinal/

The conversational agent is just one brick in a larger tutorial system whose main interest is to be able to personalise the learning experience at the learner level. These systems can guide the learner through a problem, for example by generating clues on the fly (Graesser et *al.* , 2001); they record usage traces that allow for data mining and data science. There is a desire to design interfaces to help non-specialists create their own conversational agents (Gweon et *al.* , 2005). Research can be advanced through open datasets of existing conversations such as CIMA (Stasaski, Kao, and Hearst 2020).

It has been shown that in some cases it is more beneficial for the learner to communicate with the conversational agent through speech rather than text (Rose et *al.* , 2003).

Current challenges in conversational assistance applied to education

In education, the current challenges in conversational assistants are obviously those of conversational assistance and outlined above. There is also a lack of training databases specific to data on children such as voice for example. But also on digital traces in pupils. In the field of education, it is also necessary to ensure that these tools are inclusive, and consider all recognised disabilities in order to avoid deploying discriminatory teaching methods.

To this can be added the challenge inherent in all artificial intelligence tools using learning algorithms, which is the explicability of these tools. A high level of explicability is fundamental to ensure the absence of bias or simply to guarantee the proper functioning of the tool and, in particular, its correctness and compliance with the law. This explicability is also a condition to increase the chances of adoption of the tools.

There are clearly challenges to be overcome in terms of the uptake of these tools by teachers, students and parents. There are also challenges of scaling up and challenges of the ethical aspects of collecting and processing learning data sets. Even if, according to the RGPD, education data does not have the highest level of sensitivity like medical data, it is data belonging to minors. The risks associated with its collection and processing should be taken into consideration.

Ownership and scaling up

Perceptions of artificial intelligence

In general, artificial intelligence is a subject that raises questions due to its high media exposure, which often causes controversy. There are many questions about personal data and ethical issues, for example, in connection with news such as the Cambridge-Analytica affair in 2018. It is fundamental to build a citizen and general public approach to AI to enable everyone to understand and master basic concepts to reason correctly, choose the tools to use, or remain critical and use AI technologies in an enlightened way, while asking the right questions to the designers of these technologies.

In the case of National Education, it is a matter of providing teachers, students, as well as parents and school leaders with a foundation of acculturation on AI topics (as recommended by the Villani report, *NATIONAL ARTIFICIAL INTELLIGENCE RESEARCH STRATEGY*, 2018).

The questions asked by the teaching staff are numerous and mainly concern a professional approach of the uses in education: for what and how to do it? People wonder about the potential of AI, its application and its contribution to reality. This perception is obviously different according to the teachers' training. Another question concerns the roles that AI can play in education? The educational community is mainly thinking about the role of an assistant based on AI bricks to better teach and learn, through a certain differentiation of learning and students. They are also considering applications in school guidance, but also anticipation and therefore prevention of dropping out, highlighting and optimising courses. Beyond teaching and learning issues alone, AI can support and facilitate the organisation and administrative steering at all levels of national education.

Pragmatically, AI could be considered as a teaching object like any other. The questions that arise are what to teach (curricula) and how.

Methods of ownership and scaling up

There are currently different modalities to accompany the transformations and support a move to scale:

Information and training

A series of MOOCs[19] and webinars[20] are dedicated and offered to teachers, students and parents to raise awareness on digital topics. These offerings include:

- The IAI MOOC (Class'Code Lab Inria), commissioned by the DNE, has more than 23,000 registrants over one year (since March 2020) to address AI in an intelligent way and offer a first acculturation in a citizen approach. Designed to serve as an open educational resource, its components can be reused in the training courses offered in the academies, which now also benefit from webinars organised once a month. The success of the IAI MOOC measured by a survey of more than 2000 respondents in March 2021 is reflected in both more than 40% of active users on all modules and more than 1500 requests for final certificates, almost half of users among pupils/students and teachers or 40% of women and a satisfaction and recommendation rate of over 90%. With the Finnish MOOC Elements of AI (now available in French in collaboration with the SCAI of Sorbonne University), the IAI MOOC is a precursor, even if Portugal or European School Net have also produced MOOCs with similar objectives. The IAI MOOC will serve as a basis for the training offered to French, Italian, Irish, Luxembourg and Slovenian teachers, with a more pronounced adaptation to the teaching context and a translation in the framework of the ERASMUS+ AI4T project (AI for teachers) launched in March 2021 for a duration of 36 months.
- The SCAI (Sorbonne Center for Artificial Intelligence) at Sorbonne University also offers a practical deep learning course for physics and mathematics teachers. The SCAI is in the process of preparing general AI courses for open access.
- Réseau Canopé, with the collaboration of the DNE and the DGESCO, proposes in 2021 a training course in the National Training Plan, aimed at education trainers (primarily members of DANEs). Entitled from AI to the classroom and from the classroom to AI, this action aims at accompanying trainers in a reflection on the contributions of AI in education while proposing them to create first bricks serving their future dissemination actions on their territory.
- Many DANEs, Réseau Canopé and the Ligue de l'Enseignement also provide training in algorithmic thinking, particularly in unplugged mode, in order to carry out actions from the first cycles.
- Réseau Canopé has proposed monitoring bulletins on the challenges of artificial intelligence in education which are available to all: https://www.reseau-canope.fr/agence-des-usages/dossiers-thematiques_intelligence-artificielle.html#anchor-content

[19] Massive Open Online Course. Https

[20] Online seminars, in real time or recorded.

Research and training

The GTnum-IA launched in 2020, and for a duration of 2 years, have the mission to support and facilitate research works and studies between university laboratories and academic territories. Two of them are dedicated to AI in education and aim to make good use of the potential of AI assistance without abandoning the teacher's decisions to machines. Two approaches are being studied:

- The GTnum EO_AI (education open to AI), led by the LS2N of the University of Nantes, questions the notions of prediction, anticipation, recommendation: what data for what purposes in education?
- The GTnum Scol_IA, led by the LINE of the University of Nice with the support of Inria, questions AI in education for new modes of interaction, new modes of evaluation and a hybridization of learning environments: what case studies and what frameworks for scaling up?

At the European level, the project "*AI4T": Artificial Intelligence for and by teachers*, initiated by the French Ministry of Education and coordinated by France Education International, started on 28 February 2021 for a duration of 36 months. It is a project designed by France, Slovenia, Italy, Ireland and Luxembourg to contribute to the training on artificial intelligence (AI) and its uses in education for and by teachers and school leaders on a perimeter voluntarily restricted to mathematics, sciences and modern languages (English in priority) at the high school level for students aged 15-16. It is a cooperation that brings together 17 partners (ministries, universities, training operators...) to design, implement, experiment and evaluate a device aiming at a reasoned and relevant use of educational resources containing AI, but also an awareness of their contextualization and their acceptability and an assessment of their relevance and usefulness or not in the teaching context.

Applied research, practice and support

Based on the experience of the first AI Innovation Partnership of the Ministry[21] , the model of the latter seems to be adapted to AI-related topics in education by allowing the articulation of three phases.

→ An initial applied research and development phase (12 months):

This phase allows for the use of digital services in the classroom with volunteer teaching teams in a co-construction approach between the company, the research laboratory and the teaching team in the schools.

The local monitoring carried out in close collaboration between the DANE and the Ministry (via the DNE) allows, on the basis of feedback from teachers, teachers' associations and the Ministry of Education, to

[21] https://eduscol.education.fr/1911/partenariat-d-innovation-et-intelligence-artificielle-p2ia

trainers and inspectors, all the agility and requirement to consolidate the services initially qualified in the instructions carried out via a public procurement procedure.

→ A pre-industrialisation / translational research phase (6 months):

This phase must meet the complex challenges of "scaling up" (from the laboratory to potentially "all classes"). It is then a question of consolidating the ideas and services prototyped and transforming them into industrialised services capable of meeting the demands of a very large number of users (volume effect in relation to the teachers and their pupils) and of doing so while respecting compliance requirements (security, accessibility, RGPD, etc.). This phase also makes it possible to adjust the initial roadmap for the development of the digital educational service on the basis of the experience acquired in the teaching field, the progress made in applied research and the feedback from academic and ministerial teams during the initial phase. This stage is part of the translational research that allows randomised controlled experiments to be conducted in the classroom in order to highlight the pedagogical benefits devised, as well as the technological and scientific effectiveness of the tool or method.

→ An acquisition/operational phase (several years):

This phase allows us to offer volunteer teachers access to the digital teaching service that has been co-constructed (phase 1) and consolidated (phase 2) for practices that are best suited to the challenges of teaching and differentiation.

Other schemes or projects carried out by the Ministry, academies and local authorities also combine applied research, practices and pedagogical support. Let's mention the support to pedagogical resources including AI through the Edu-Up device, the prototyping of a solution for learning English among schoolchildren (Captain Kelly), several proposals of challenges presented by public entities to Edtechs in the Challenge Education, or regional initiatives such as the Campus IA IDF or the house of AI in Nice (Terra Numérica project) as examples

- AI is one of the priority areas of the Ministry of Education's Edu-Up support scheme (https://eduscol.education.fr/1603/le-dispositif-edu). One of the recent supports concerns the use of the AlphAI robot (Learning Robots), an innovation from the CNRS to make the concept of *machine learning* concrete by carrying out learning in real time. The graphical interface of the same name opens up the visualisation and control of the AI algorithms that govern it: from supervised learning to reinforcement learning, from the nearest neighbour algorithm to artificial neural networks (https://learningrobots.ai/). The solution is being tested in the IA IDF campus or in the Nancy-Metz academy, for example.
- With Captain Kelly, the Ministry has committed itself, within the framework of an experiment, to supporting the development of a digital solution based exclusively on

on oral interactions, to assist the teacher in conducting English language activities, to build the pupils' lexical and syntactic knowledge and to train their comprehension and pronunciation in English. https://eduscol.education.fr/1285/un-plan-d-actions- pour-unemeilleure-maitrise-des-langues-vivantes-etrangeres

- The "Education Challenges" aim to encourage open innovation between companies or public entities facing digital challenges related to education and teaching on the one hand, and companies developing innovative technologies on the other hand, and likely to bring about radically new solutions for all stakeholders. The proposals of several sponsors (administrations, rectorates, public operators) selected aim at using AI and massive data to improve the training paths of managers and teachers, to improve the personalisation of learning paths, etc.
- (https://www.bpifrance.fr/A-la-une/Appels-a-projets-concours/Challenges-Education-Call-for-interests-Sponsors-wave-1-51163)
- Several territorial projects initiated by local authorities, conducted in close collaboration with the academies and involving more or less directly the Ministry, are based on the same principles, as is the case with the Campus IA IDF based at the Lycée Paul Valéry in Paris or the project of an IA house for schoolchildren in Nice (Terra Numérica).

Current challenges and work on ownership and scaling up

Accompanying and embarking

AI, because of its intangible, often complex and still too stereotyped character, can frighten or even be rejected by teachers, students and parents. Accompanying each group in an adapted way, at a personalized pace and with different objectives, allows each actor in education to be involved for the good of everyone. Understanding what AI is already doing, what it is not yet doing, and what it will probably never do, is a first step in highlighting the opportunities, benefits and threats.

The challenge of intelligibility and comprehensibility of the discipline is specific to all citizens. It is fundamental that the National Education builds a corpus of pedagogical materials, in collaboration with external scientists and engineers, to allow a simple and efficient access to AI, to capture its stakes, and to facilitate *in fine* the scaling up of research tools in schools.

Better value and better protection

There are many challenges to be met in order to enhance initiatives by and for national education, while protecting teachers, students and parents.

It is important to properly evaluate the type of AI mobilised, such as its composition, the type of datasets on which the AI has been trained and/or calibrated. But also its effectiveness in real teaching and learning situations, this allows to underline upstream the potential and the obstacles of a scaling up.

In order to guarantee a framework of trust and to increase the ease of discovering and accessing digital educational services, it is important to adhere to the technical modalities made available by the State and the local authorities. In this respect, connections with digital work environments (ENT) via the Resource Access Manager (GAR)[22] offer all the requirements to guarantee the protection of pupils' and teachers' personal data.

The work carried out by and for the French Ministry of Education must constantly be placed in the perspective of the development of the education data access platform (data hub education and its precursory work with the LORIA's open learning analytics laboratory (LOLA)[23]). This will optimise the dimensioning of this platform as well as the dynamics of creating and pooling data sets for the needs of research and the production of new solutions.

In the case of technologies that are being tested or are already in use, the aims and methods must be explained precisely and intelligibly, as must the effort to be transparent and to adapt the language register, including on technological subjects.

In order to support the digital transformations underway via the availability of new services based on artificial intelligence bricks and to address different audiences (teachers but also parents and pupils), it is necessary to continue training teachers over the long term and it would be useful to have a "general public" type of website that would allow them to become acculturated to the technological possibilities at the service of education.

Thus, for example, each of the six solutions of the AI Innovation Partnership initiated by the Ministry has a "companion site" open to all, allowing to discover the digital services, to get information and to register (for teachers). This discovery method contributes to the need for transparency and acculturation to the potential of AI in education.

It is also crucial to work in close synergy with research from the design to the evaluation of digital educational services by carrying out studies to regularly check the quality and improve the solutions in real classroom situations.

[22] https://gar.education.fr/
[23] https://www.loria.fr/fr/

Furthermore, it is fundamental to conduct legal work inherent to AI-based digital services to ensure the framework of trust with teachers, students and parents. Demonstrating compliance with the RGPD[24] is mandatory, for example through data protection impact assessments and analysis of the data flows collected, stored and used.

Recommendations and perspectives

Pedagogy and co-design

In order to enlighten all the actors of the society, AI must be studied and known from all points of view (mathematics and computer science; economic sciences; philosophy, sociology, education sciences, political sciences, …). Its contributions must be known both in terms of technical efficiency, as well as the ethical issues it raises and the social and economic impacts it will have. This can only be achieved through a strong acculturation and support around the issues of data education; to train managers and teachers on the potential of AI and on how to bring the ethical questions that AI may raise to their different audiences (students, parents). In parallel to a broad mediation for the general public, as recommended by Cédric Villani in his report (Villani, 2018), the French National Education system must increase its efforts to promote acculturation through training, events, exhibitions and the provision of educational content for teachers.

At the same time, the national education system must accentuate and promote all actions allowing a good acculturation of AI, and continue to question the representations and needs of teachers.

In education, as elsewhere, and in the interests of maximum acceptance, it will be essential to involve learners and teachers in the design of tools and services using AI.

Among the recommendations and perspectives, we are interested in the development of conversational agents and their experimentation in the classroom, as well as in the use of commercial tools and their appropriation by students, teachers and parents.

Recommendations for the development of conversational agents

How to manage a conversational interface project that satisfies the user

Studies in the literature on chatbots show that **it is effective t o use instant messaging platforms where users are already present to**

[24] General Data Protection Regulation.

build a custom chatbot on top of[25] **.** TechCrunch, for example, sends five articles daily via the Facebook Messenger application. As the chatbot stack is composed of three parts (the chat interface, the language process layer and the database access layer), if some components are already present in other applications, it is possible to reuse them.

- **Adapt to the type of user:** depending on the type of user the platform is aimed at, the solution must be adapted: baby boomers prefer phone calls to instant messaging[26] , younger people no longer want Facebook Messenger (bots can be designed through this platform), etc. The solution must be adaptable depending on whether the student or the teacher/parent uses it.
- **Ensuring technological inclusion and integration of pupils with disabilities:** it is fundamental to develop inclusive tools for all pupils, taking into account differences in levels, difficulties of some pupils, or disabilities. Conversational assistants must be designed both in terms of the algorithm and the user interface to enable children with disabilities to use them. In addition, some tools can be specially designed to help students with disabilities. The design should be thought of in this way from the start of the design and development process.
- **Establish usage objectives:** the objectives of the conversational interface must also be well established: **adoption, engagement and then effectiveness**. Sometimes all three cannot be achieved from the start. Choose who will respond: the human or the machine. Start by building an MVP to learn what users really want if it is not fully known at the beginning. The chatbot will learn from past conversations. The more it has, the better.[27]
- **Guarantee the reversibility of the platform and data:** do not become dependent on a single supplier. Ensure that the interface services can evolve independently of the supplier if necessary.

Assessing turnkey solutions

No provider can be successful without a robust intent model, perfect security/authentication, and multi-channel capability (social networks, mobile apps, messaging apps etc).[28]

To evaluate and compare conversational agent solution providers, it is essential to understand the overall architecture of the solutions as well as the different specific services offered at each stage. Many providers do not use AI

[25] Peter Wannemacher. Bots Aren't Ready To Be Bankers. Forrester study, 2016

[26] Julie A. Ask and Andrew Hogan. Chatbot commerce Benchmark. Forrester study, 2016

[27] Michael Facemire, Julie A. Ask, and Andrew Hogan. Chatbots 101: Building Conversational Interfaces, Forrester Study, 2016

[28] Ian Jacobs. The Top 10 Chatbots For Enterprise Customer Service. Forrester study, 2016

but knowledge that has been sorted out a priori[29] . Many users expect to benefit from very advanced AI models and may be disappointed by an experience that does not live up to their expectations.

The industry has taken different approaches to offering conversational services. The offer can be categorised according to different criteria:
The type of user :

- chatbots,
- virtual customer assistants (VCA, adapted to automate text-based engagement channels such as live chat, consumer messaging applications or SMS),
- virtual personal assistant (VPA)
- virtual enterprise assistant (VEA)

The uses[30] :

- social chatbot (unstructured conversations "as a human would discuss"),
- bots oriented to a specific task: either several simple everyday tasks or more specialised tasks such as information retrieval (ordering food, booking a flight, etc.).

The technology :

- Bots based on strictly encoded rules,
- Data-driven bots.
- A combination of the two previous points: use of learned rules and data.

The basic architecture consists of a connector (voice or text messaging platform), an NLP brick to understand the semantics of the user query and a decision tree or simple model to select a possible answer[31] . This is a base, but the different providers need to differentiate themselves by offering more services.
For most chatbot solutions, there is no specific user interface and the conversational service is embedded in a messaging system where the user is already present
Messenger, WeChat, Kik for example. These media allow for diversification in the type of user request such as image processing, but it locks the solution into a specific messaging platform.
For VPA and VEA, a specific user interface is more often developed.

Criteria for assessing the integration capabilities of a solution :

[29] Magnus Revang, Brian Manusama, Anthony Mullen. Architecture of Conversational Platforms. Gartner study, 2017.
[30] Maali Mnasri. Recent advances in conversational NLP: Towards the standardization of Chatbot building. Preprint, 2019
[31] Magnus Revang, Brian Manusama, Anthony Mullen. Architecture of Conversational Platforms. Gartner study, 2017.

- multi-user configuration,
- the diversity of possible requests (texts, images, videos, a combination of the 3, etc.),
- the length of the query allowed (most NLP bricks accept a maximum length of input text. This length can be a differentiating factor).

Criteria for assessing the voice :

- recognition of the user's voice,
- biometric authentication,
- language detection, etc.

Criteria for evaluating the NLP brick :

- semantic enrichment of queries using internal knowledge bases,
- specification of the model driven (or not) on a use case specific dataset (or generic default model),
- continuous learning of the model over time (or not).

Criteria for assessing query intentionality matching (linked to the NLP brick) :

- contextualisation,
- possibility of choosing between different models depending on the type of intentionality,
- extraction of recurring and well-identified patterns ("play a song"),
- prioritisation in the elements of a query "order a book" then "deliver to the right address".

Criteria for assessing how the response is generated :

- natural language generation,
- dialogue,
- *text to speech*
- ...

Finally, some solutions can generate usage reports with specific metrics.

Evaluating chatbots that use machine learning

The systems no longer depend on deterministic responses from rule-based pattern matching, such as ELIZA and ALICE. The evaluation is therefore more complex.
Divide the responsibility for testing between the service provider (who is responsible for testing inputs, execution of actions and realism of responses) and the client (who evaluates usability and efficiency of task completion)[32] . To evaluate a new scrabble or a new version of the scrabble (e.g. retrained on new data), engineers select the following quality evaluation criteria

[32] Nicole Radziwill and Morgan Benton. Evaluating Quality of Chatbots and Intelligent Conversational Agents. Preprint 2017

actions (without business metrics) and users select business metrics (efficiency to help achieve a task).

In generative models, decoders and response length are particularly important. The length of the response can be set as a minimum or predicted from human-human dialogue data[33] . The training process is often done by pre-training on a large volume of data and then refining on use case data that is usually available in smaller volumes. The dialogue data that is available in large quantities must nevertheless be chosen carefully to anticipate problems of gender bias, discrimination, etc. Ways to reduce these biases by choosing to generate more neutral words.[34] The quality of the text generator is very important for the final result: answers that are too short are perceived as boring or showing a lack of interest, and answers that are too long are perceived as the bot not listening. There are different choices of bot architecture: those that generate answers by selecting the relevant answer from a fixed set of candidate answers (retriever), those that generate text (seq2seq) or a combination of both to overcome the problems of generative models that may be repetitive or not very suitable for learning new knowledge over time.

Recommendations for deploying a chatbot solution

- **Assess the need to incorporate machine learning into a chatbot**: at the beginning of a project, it is not necessarily necessary to incorporate learning algorithms into chatbots so that they can continuously improve as the number of conversations and interactions increases. A static solution can be used initially as some tasks do not require a deep understanding of context and semantics. Choosing one technique over another depends on the data available at the start of development (volume, structured or not, labelled or not) and the final use case[35] . Rule-based techniques are simplistic but effective in the most basic cases. They can also complement a machine learning model. Machine learning based approaches are now dominant. Reinforcement Learning learns from user feedback over time and the experience is continuously improving, making it very natural. But there is a constraint to keep in mind: the technology needs a lot of time and a lot of interaction before the conversational agent is trained in a way that is meaningful to the user.

[33] Roller S, Dinan E, Goyal N, Ju D, Williamson M, Liu Y, Xu J, Ott M, Shuster K, Smith EM, Boureau YL. Recipes for building an open-domain chatbot. arXiv preprint

[34] Dinan, Emily, et al. Queens are powerful too: Mitigating gender bias in dialogue generation. Preprint, 2019

[35] Maali Mnasri. Recent advances in conversational NLP :Towards the standardization of Chatbot building. Preprint 2019

satisfactory. If the training is done online, this may cause problems for first-time users.

- **Assess current bot frameworks for potential use in the intended context**, both for their applicability to tasks (use cases) and for the benefits they offer users in terms of efficiency and ease of use[36] .
- **Do not fragment the user journey**. VCAs provide a better understanding of users; when users communicate in a natural, conversational way, they reveal more about their preferences, opinions, feelings and inclinations. Integrate multiple knowledge bases within the VCA[37] .
- **Deploy at least one chatbot framework in-house** and start actively developing analytics bricks to evaluate their use, focusing on current weaknesses in use cases[38] .
- **Ensure a strong and clear consensus on the rationale and investment objectives**. Focus on the objective of the application case and educational and scientific input, keeping to the trend factor. Improve incrementally. The development of an application should provide results quickly with low start-up cost, minimal risk and additional opportunities to extend the use easily[39] .
- **Ensuring the inclusiveness of the technology**. There is a need to assess how the given technology considers the whole range of student and teacher profiles. This includes students with disabilities. A list of disabilities should be used to validate whether the proposed technology is inclusive of all students with these disabilities. It is essential to include this in the tests to be validated during deployment and production.

Classroom experiments

Here are some recommendations on classroom experimentation with the aim of facilitating them, building trust with teachers, students and parents, and maximising the benefits for the school and the researchers.

- **Co-design and co-construction**
  - Encourage the co-construction phases of the research and development teams with the teams in the field during iterations and/or during the deployment of solutions in the classroom;
  - Include parents in this co-construction phase,

[36] Van L. Baker, Magnus Revang. Four Use Cases for Chatbots in the Enterprise Now. Gartner Study, 2016

[37] Brian Manusama. Market Guide for Virtual Customer Assistants. Gartner study, 2016

[38] Van L. Baker, Magnus Revang. Four Use Cases for Chatbots in the Enterprise Now. Gartner Study, 2016

[39] Brian Manusama, Frances Karamouzis, Tom Austin. Seven Decision Points for Success With Virtual Customer Assistants. Gartner study, 2016.

- **Pedagogical support** - Guiding the teaching teams upstream and downstream of the during the use of AI-based digital services;
- **Collecting feedback** - Sharing, via feedback arrangements, points of improvement between users (educational teams) and designers (solution providers/distributors);
- **Communication of points of vigilance** - Detail practical advice and points of vigilance (information versus consent, chain of actors to be involved, transparency, support, communication)
- **360 degree experimentation for inclusion** - A comprehensive and inclusive experimentation, which should include pupils with disabilities for example, or children with severe learning difficulties. Such an experimentation increases the confidence of teachers, pupils and parents in the use of such AI technologies by ensuring their inclusiveness.

Scaling up

Here are some recommendations on scaling up AI tools in schools to facilitate deployment and post-deployment when the tools are used extensively in the classroom.

- **Updating of programmes** - Regularly aligning programmes (in line with the rapid developments in AI) with an AI curriculum from primary schools to university (in line with the European DigComp Edu and the Digital Competence Reference Framework (DCRF) assessed via the PIX tool)
- **Provision of training** -
    - Propose training plans in all academies on AI to management staff, pedagogues, etc.
    - Set up open platforms for the provision of explanatory content designed by people outside the national education system (engineers, entrepreneurs, etc.) and labelled "validated by the Ministry". This content is complementary to institutional training.
- **Valuing the role of teachers in these research actions**. Engage and train teachers in action research. Engage researchers in a real collaborative practice around their educational research issues. To promote collaborative approaches between the different actors (research, edTech, academia) within French and European research.
- **Valuation of current experiments** - identify and value known experiments (whatever the scale) for factorisation and dissemination between territories (e.g. TNE approach)
- **Initiate new AI innovation partnerships for education** - Use this innovative public procurement modality to facilitate a rapid scale-up from lab to classroom (one year of R&D and co-construction in the classroom followed by 6 months of pre-industrialisation followed by a possible

acquisition and deployment at national level) - targeted at schools, colleges and high schools: assisting teachers to improve the learning of their pupils in French, mathematics, science or modern languages.

- **Exploring the possibilities offered by AI in the exploitation of data from central administration services, rectorates or operators** - Using the innovation challenges in the framework of investments for the future to develop POCs facilitating the use of AI to improve the organisation of training courses, teachers' career paths or students' education.
- **Accompanying EdTechs in AI** - Offering EdTechs support programmes that meet a framework of educational, technical and ethical trust, in order to support economic and research activity on the contributions of AI in education and to push forward innovative solutions that meet the needs of the educational community.
- **National and European influence and collaboration** - Support and promote the need to work on the "AI and education" theme on a national or European scale by making greater use of the ERASMUS+ mechanism and by linking MENJS actions with the implementation of the new European digital plan for education (DEAP 21-27)

Conclusion

In this report, we have presented a state of the art with representative but not exhaustive references of the work and advances in the field of conversational agents and more particularly in the field of education. To do this, we conducted interviews with a dozen researchers and engineers specialised in the field in order to orientate our bibliographic research.

We also conducted a survey of teachers, school headmasters, and students on their perception of artificial intelligence. These hearings highlighted the challenges of future adoption and the pedagogical work to be done on the part of both educational staff and students, but also parents.

We proposed practices for the implementation, development and use of smart assistants for education. To this end, we focused on the technical and pedagogical aspects of deploying ethical, responsible and inclusive tools, in order to increase the level of adoption and allow the tools to evolve in the right direction.

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Annexes

ANNEX 1: Composition of WG6

ACTIVE MEMBERS

First name	Name	Function
Alain	Thillay	Head of the innovation and applied research office for the DNE
Aniseed	Ayari	Lead Data Scientist & Entrepreneur
Anne	Boyer	Research Professor at the University of Lorraine
Aurélie	Jean	Scientist and Entrepreneur
Axel	Jean	IA and Education Officer, TN2 Office - DNE
Jean-François	Cherry tree	Professor of Information and Communication Sciences communication
Jean-Michel	Perron	Director of R&D on the uses of digital education - Réseau Canopé
Melina	Solari Landa	Head of studies at Réseau Canopé, researcher in Information and Communication Sciences
Jill-Jenn	Life	Research Scientist at Inria
Romain	Vanoudheusden	Acting Director of R&D at Réseau Canopé
Victor	Storchan	VP - AI ML Lead at JPMorgan Chase & Co.

OBSERVER MEMBERS

First name	Name	Function
Emilie-Pauline	Gallié	Inspector General of Education, Sport and Research at IGESR
Magali	Clareton	Inspector General for Education, Sport and Research

APPENDIX 2: Researchers and experts interviewed by WG6 on their work and their vision of AI in education

First name	Name	Function
Emma	Brunskill	Assistant professor in the Computer Science Department at Stanford University
Daniel	Schwartz	DEAN OF THE GRADUATE SCHOOL OF EDUCATION AND THE NOMELLINI-OLIVIER PROFESSOR OF EDUCATIONAL TECHNOLOGY
Gautam	Biswas	Cornelius Vanderbilt Professor of Engineering Professor of Computer Science Professor of Computer Engineering Professor of Engineering Management
Steve	Ritter	Founder and Chief Scientist Carnegie Learning
Agneta	Gulz	Professor of Cognitive Science, Linköping and Lund universities
Ken	Holstein	Assistant Professor at Carnegie Mellon University
Andrew	Lan	Assistant Professor at University of Massachusetts Amherst
Pink	Luckin	Professor of Learner Centred Design, UCL Knowledge Lab
Antoine	Bordes	Director - FAIR - Facebook
Anne	Boyer	Research Professor at the University of Lorraine

APPENDIX 3: Questions on the form from researchers and experts interviewed by WG6 on their work and their vision of AI in education

	QUESTIONS
1	Can you tell us in a few lines the major projects you are carrying out (in progress or prospective)? What type of experimentation are you doing (e.g. to validate a system ? an algorithm ? an approach ?)? Can you describe the experimental field of a or two of your experiences (level of teaching, number of students, duration of the experiment)? What are the main difficulties you encounter?
2	How do you think intelligent tutors can support the student in learning and the teacher in working? What will the tool never do, and for which the teacher remains fundamental? Are there things that an intelligent tutor can do that the teacher cannot?
3	In your experience, how do students, teachers and parents can perceive the use of an intelligent tutor?
4	Which student and teacher data do you think are most interesting to collect and analyse? What are the obstacles to do so? What advantages (personalised learning, national performance assessment, ...) and disadvantages (ethics and reputational risk) for the students, the class, the teacher, and the ministry do you identify in the use of this type of data?
5	In your opinion, are there differences between countries in terms of technological advances and the use of AI tools and assistants in education? Which countries are the most advanced? How do you explain this?
6	Are there any other points that you would like to draw to our attention?

APPENDIX 4: Questions from the WG6 hearing form on fears and hopes placed on AI.

QUESTIONS ASKED

	QUESTIONS
1	Profile questions (gender, age, length of time in education, location geographical) preceded by a question to filter respondents according to the type of actor (manager, teacher, parent and pupil) and a self-positioning on their comfort with digital technology
2	A hierarchical evocation test (not compulsory): "When someone talks to you about artificial intelligence in education, what words come to mind? List 5 words in order of importance (the first being the most important)".
3	A list of assertions with advantages and disadvantages of AI in education (mandatory part). The assertions are presented in a random order. The following table lists 14 statements about the use of artificial intelligence in education. Choose between 4 and 7 statements maximum with which you feel most in agreement.
	See the following table. The assertions are proposed by respondent type. The disadvantage and advantage typologies are not shown on the screen and are only an indication for the analysis
4	To go further (non compulsory part), we suggest to respondents to : - Give us their contacts if they want to participate in interviews later. - An open text space to leave any kind of comment in relation to AI in education. This part will be processed only to guide a possible second version of this questionnaire.

STATEMENTS ABOUT THE PERCEPTION OF ARTIFICIAL INTELLIGENCE BY TEACHERS AND STAFF, STUDENTS AND PARENTS OF STUDENTS

	Teachers and staff of the EN	Pupils (middle and high school)	Parents of students
Disadvantages (fears)	AI could focus on apprenticeships quantified by digital data to	AI could help the a profusion of examinations at multiple choice at to the detriment of the	AI could help the a profusion of examinations at multiple choice at to the detriment of the drafting

	to the detriment of other forms (the social learning for example).	writing and argumentation on any topic.	and argumentation on any subject.
	AI could help teachers make decisions about students' education based on numbers alone.	AI could help teachers make decisions about my schooling based on numbers alone.	AI could help teachers make decisions about my children's schooling based solely on figures.
	AI could reduce the diversity of students' interests.	AI could reduce my interests by limiting me to the recommendations (educational, resources, etc.) that the algorithms give me. propose.	AI could narrow down my child's interests to the recommendations (educational, resources, etc.) that the algorithms propose.
	The AI could reduce the importance of the teacher in supporting the work of the student.	The AI could reduce the teacher's presence in the support of my work.	AI could reduce the teacher's control over my child's work.
	AI could increase the amount of time students spend in front of digital terminals.	AI could increase the time I spend at terminals digital.	AI could increase the amount of time my child spends in front of digital terminals.
	AI could reduce teachers' pedagogical freedom.	AI could constrain the teacher's freedom to choose the teaching methods that suit him/her seem more relevant.	AI could constrain the freedom of the teacher to choose the teaching methods that seem most relevant.
	AI could increase disparities between students.	AI could increase disparities between students.	AI could increase disparities between students.

Benefits (hopes)	AI could reduce the administrative workload of teachers and	AI could reduce the administrative workload of teachers, leaders	AI could reduce the administrative workload of teachers and managers.
	frames.	establishment, etc.	
	AI could facilitate the curation of personalised educational resources for teachers.	The AI could offer me educational resources adapted to my level and my needs. knowledge.	AI could offer educational resources tailored to my learning pathway. child.
	The AI could promote pedagogical differentiation by offering students a pathway and follow-up personalised.	AI could provide me with learning paths that match my interests and my level.	AI could provide learning pathways that meet my child's interests and level.
	AI could reduce dropout by identifying students' difficulties early on.	AI could help me succeed in school by providing feedback on what I'm doing well and what I'm not doing well.	AI could help my child succeed in school by providing feedback on what he or she is doing well and what is going wrong.
	AI could detect drifting behaviour such as bullying.	AI could detect risky behaviour for me or other students such as bullying school.	AI could detect risky behaviour for my child or others, such as bullying.
	AI could facilitate the dynamic creation of need groups with diverse profiles.	The AI could offer me compatible working groups according to my needs or profile.	The AI could suggest work groups that are compatible with my child.
	AI could allow students to practice and make mistakes without fear of being judged.	AI could allow me to practice and make mistakes without fear of being judged.	AI could allow my child to practice and make mistakes without fear of being judged.

APPENDIX 5: Elements of AI representation in education.

		AVERAGE RANK	
		Less than 3.30 CENTRAL CORE AREA	Equal to or greater than 3.30 FIRST PERIPHERY
FREQUENCY OF OCCURRENCE (%)	Greater than or equal to 36.9	personalised teaching resources (+) personalisation of courses (+) Successful schooling through educational differentiation (+) dynamic creation of groups (+) practices without fear of being judged (+)	increase in screen time (-) reduction of the administrative burden on teachers (+)
	Less than 36.9	increase disparities between pupils (-)	focus on quantified learning with numerical data (-) help to standardise based on numbers (-) reduce diversity of interests (-) less teacher support (-) loss of teacher freedom (-) detect risk behaviour (+)
		CONTRAST ELEMENTS	SECOND PERIPHERY

. APPENDIX 6: Dependency between the ranking of the proposed assertions and the profiles.

Profile	Assertion	Class.	Chi-square
Teachers and teaching assistants	increase in screen time (-)	1	X2 =139.4 ddl=52 p=0.001
	increase disparities between pupils (-)	2	X2=98.0 ddl=52 p=0.001
Agent MENSJ	customisation of courses (+)	1	X2=139.4 ddl=52 p=0.001
	practices without fear of being judged (+)	2	X2=98.0 ddl=52 p=0.001
	customised pedagogical resources (+)	2	X2=98.0 ddl=52 p=0.001
	reduction of the administrative burden on teachers (+)	4	X2=68.6 ddl=52 p=0.061
Body inspection	dynamic creation of need groups (+)	1	X2=139.4 ddl=52 p=0.001
	customised pedagogical resources (+)	4	X2=68.6 ddl=52 p=0.061
	Successful schooling through educational differentiation (+)	4	X2=68.6 ddl=52 p=0.061
Pupil's parent	reduce diversity of interests(-)	1	X2=139.4 ddl=52 p=0.001
	customised pedagogical resources (+)	1	X2=139.4 ddl=52 p=0.001
	increase in screen time (-)	2	X2=98.0 ddl=52 p=0.001
	reduce diversity of interests(-)	2	X2=98.0 ddl=52 p=0.001
	customised pedagogical resources (+)	2	X2=98.0 ddl=52 p=0.001
	Successful schooling through educational differentiation (+)	2	X2=98.0 ddl=52 p=0.001
Student	less teacher support (-)	1	X2=139.4 ddl=52 p=0.001

	reduction of the administrative burden on teachers (+)	1	X2=139.4 ddl=52 p=0.001
	loss of teacher freedom (-)	4	X2=68.6 ddl=52 p=0.061

Figure 6

APPENDIX 7: Structure of teachers' representation of intelligence in education.

		AVERAGE RANK	
		Less than 2.9 CENTRAL CORE AREA	Equal to or greater than 2.9 FIRST PERIPHERY
FREQUENCY APPARITION (%)	Greater than or equal to 7.8	need for digital equipment (2.8; 29.6%) programming (2.5; 26.6%) differentiation / customisation (2.4; 24.2%) robot (2.2; 22.3%) algorithm (2.5; 19.3%) digital (2.0; 9.9%) technology (2.8; 8.6%) learning (2.8; 8.2%) automation (2.4; 7.9%)	help / assistance (2.9; 22.5%) performance (3.1; 13.7%) dehumanising (3.2; 13.3%) data analysis and processing (2.9; 12.2%) future (3.0; 10.7%) change (3.6; 8.2%)
	Less than 7.8	illusion (2.8; 6.7%) AI technologies (2.7; 6.7%) tool (2.8; 5.6%) innovation (2.6; 5.2%) complementary school courses (2.8; 4.5%)	distrust (3.0; 7.5%) potential (3.0; 6.9%) autonomy (3.0; 6.7%) worrying (3.4; 6.0%) control/exerciser (3.2; 5.8%) need for regulation (3.3; 5.4%) teacher replacement (3.0; 4.9%) training needs (3.7; 4.7%) supervision (3.2; 4.3%)
		CONTRASTING ELEMENTS	SECOND PERIPHERY

Figure no.

Figures

FIGURE 1: Distribution of respondents by profile in education.

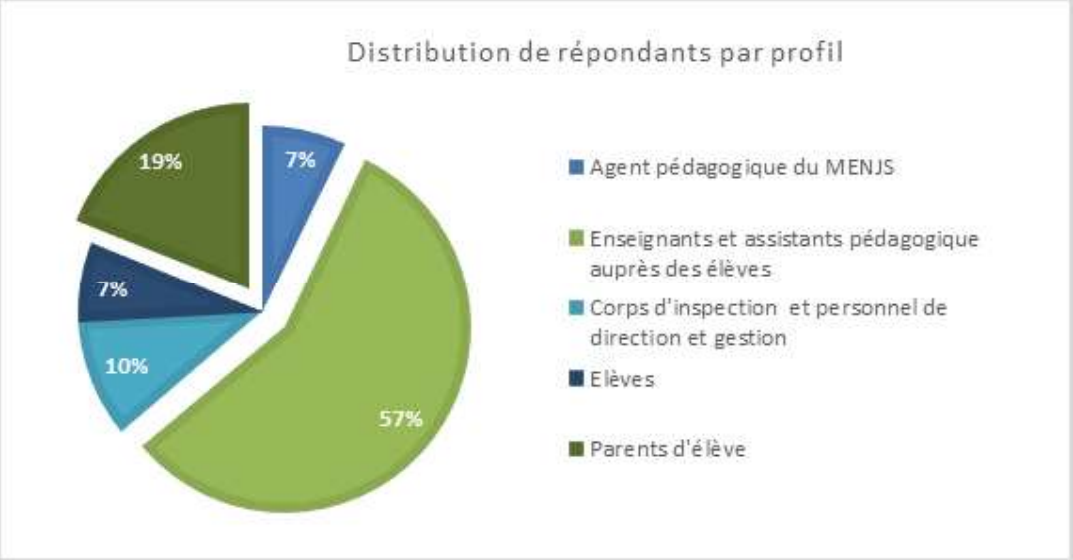


FIGURE 2: Percentage of respondents according to their profiles and professional experience

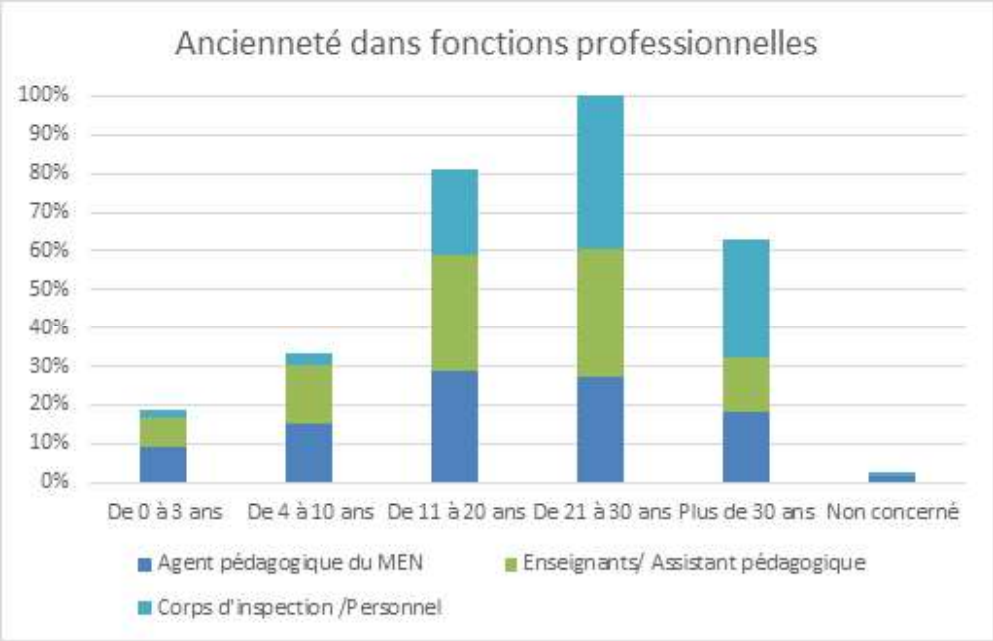


FIGURE 3: Distribution of respondents according to their place of practice or study.

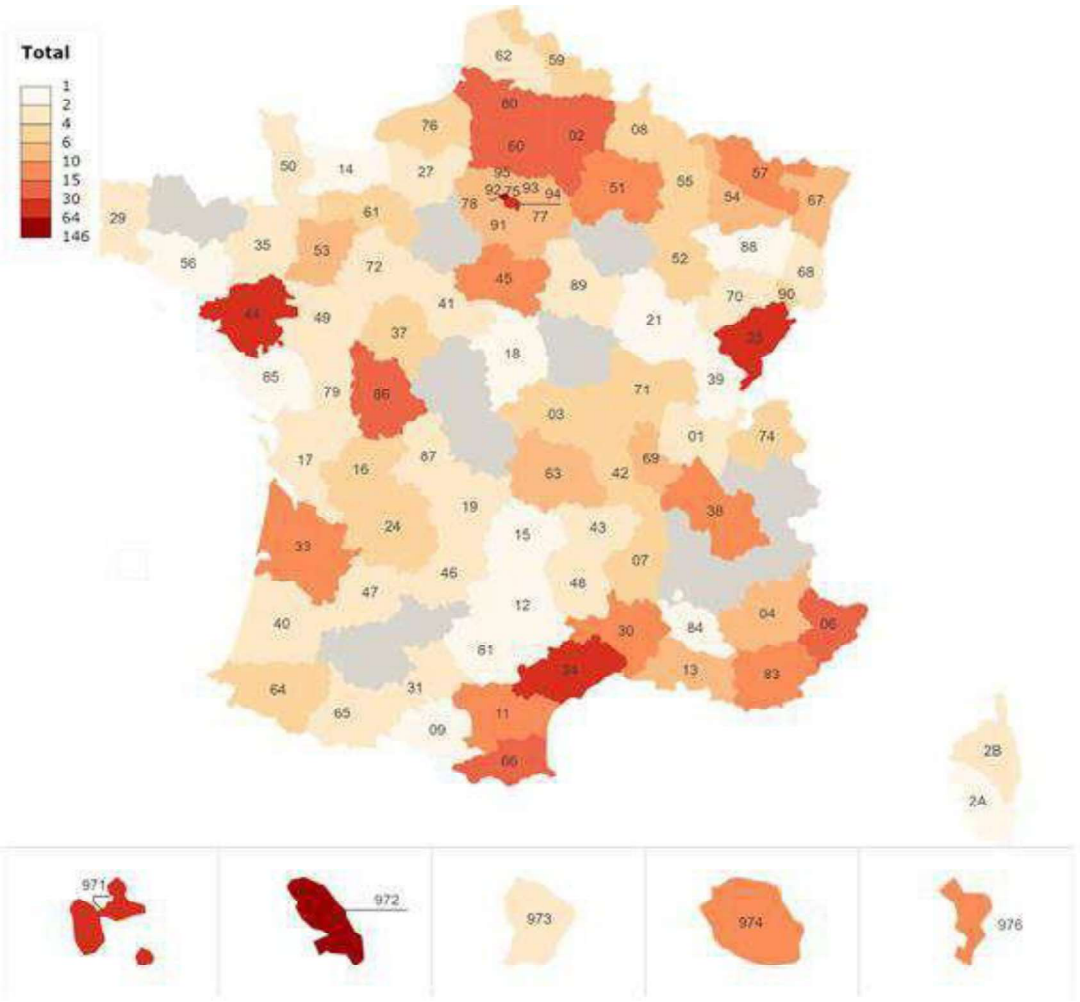
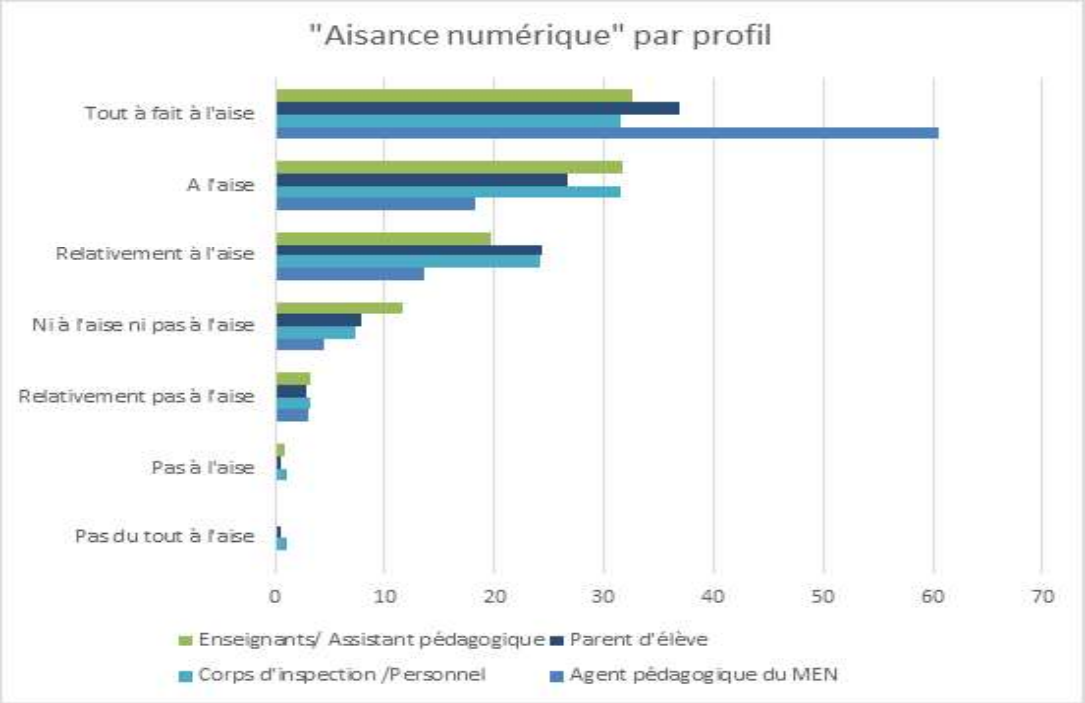


**FIGURE 4: Percentage of respondents who feel comfortable using digital technology in
depending on the profile.**



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