FROM DIGITAL TECHNOLOGIES TO AI: *WHAT DO MATHS TEACHERS THINK ACCORDING TO THE INITIAL RESULTS OF THE EUROPEAN PROJECT AI4T?*

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Introduction (1)

Buongiorno a tutti, sono felice di essere qui con voi oggi. E mi dispiace, questa è l'unica frase che dirò in italiano, il resto sarà in inglese. Spero che tu capisca!

- Thank Franco & the evaluation team

Before I begin, I would like to thank the organisers of this conference, and in particular my friend Franco for this opportunity to talk about the AI4T project. I would also like to thank the entire evaluation team who worked on the project and gathered the data that I will present you. My special thanks go to my colleague Aurélie, who is leading both the evaluation of the project for France and the coordination of the international team, and who helped me prepare this presentation.

For the record, I met Franco a long time ago on another European project about use of digital tools for education in initial teacher training and now, twenty years later, here we are to talk about a new European project but this time on *AI* in education.

- The importance of AI (2)

With the boom of generative AI at the end of last year (I mean ChatGPT), there has been a lot of attention on this topic. Some question whether AI is the 4th revolution after the printer, the computer and the internet. The AI4T project was born out of the awareness that AI is a phenomenon that impacts education (whether we want it or not). As said by the Joint Research Centre of the European Commission in 2020 "*A wide range of technologies, applications and services aimed for educational purposes stemming from Artificial Intelligence (AI) […] are emerging. They could potentially impact significantly on the way learning and teaching will take place in the coming years.*"

- What does the research tell us (3)

I'd like to insist on "potentially" and "significantly" because we have extensive literature on digital technologies in education and we know that they can be beneficial, as well as neutral, or even detrimental. It all depends on what they are, how they are used, for which functions and which students. The average effects mask very wide variations in results. This means that tools alone are often not enough to automatically improve learning (Tricot, Cnesco, 2020). For example, meta-analyses show that the use of digital technologies is rather beneficial for students in calculating and problem solving, but with limited effects in discovering abstract concepts.

A recent study analysed the latest four PISA surveys, from 2009 to 2018, to explore the association between students' ICT-related use and math and science performance. This study revealed that, in general, an increase in ICT availability and ICT use, both inside and outside school, had a negative association with learning outcomes, while students' positive attitude toward ICT demonstrated a strong positive relationship. However, students' perceived autonomy related to ICT use had the strongest association with academic performance, which is consistent with the changing nature of the modern learning environments. (Matthews et al., 2022)

https://largescaleassessmentsineducation.springeropen.com/articles/10.1186/s40536-022-00128-6

- Context and genesis of the AI4T project (4)

Our main objective with the AI4T project was to accompany the development of AI to ensure that it benefits pupils, starting by looking at how teachers understand it and use it. Comparing to "traditional" digital tools, AI technologies seems to bring many new possibilities for education, such as personalised learning through intelligent tutoring systems, or automatic essay corrections (just to give a few examples). It is important to investigate how these new tools can bring real added-value to students because research on the benefits of AI tools for students is currently scarce.

Another reason why AI impacts education is because it impacts society as a whole. Remember what you heard yesterday: "*non possiamo fare come se*

l'elaboratore electronico non existere". Today, I say : "*non possiamo fare come se l'intelligenza artificiale non existere*". Children will live in a world full of AI. We need to think about what students need to learn now that they have access to all of these tools. Whether they are beneficial for learning or not, the students will use AI tools, and teaching strategies should take that into account. All these questions are not new. Other digital technologies before AI raised the same questions : remember for example the integration of the calculator or the geometry softwares in math lessons.

Convinced of the importance of the subject, in 2020, we submitted the AI4T project, known as Artificial Intelligence for and by teachers, as part of the Digital education action plan of the European Commission. It was a very ambitious project at a time when AI wasn't as talked about and when there wasn't much research on AI in education.

We had some expectations that teachers maybe wouldn't have a clear idea of what AI was and that they would have some apprehension about integrating these new technologies into their practice. Therefore, teachers would need professional learning to help them understand AI and what it can do for teaching and learning. So, a course has been designed during the project, it was a general professional learning pathway on AI, that was targeted for both mathematics and language teachers. The project was evaluated through a randomised controlled trial during which we gathered data on teachers' knowledge, perceptions and use of AI. For those who don't know what it is, a randomised-controlled trial involves randomly dividing teachers into two groups, one which receives a treatment (called the experimental group) and the other doesn't (called the control group), and evaluating consists in studying the differences in results between the two groups through a baseline questionnaire and an endline questionnaire.

- Questions (5)

On this slide, you can see some of the questions that we pondered and that can be answered thanks to the data we have collected:

- Do teachers know the difference between digital technologies that contain or do not contain AI?
- Do teachers use or want to use AI?
- Are teachers afraid of AI?

Presentation of the AI4T project (6)

- Key information: Erasmus+, duration, partners… (7)

Let me give you some key information about the AI4T project. It is an Erasmus+ project key action 3, funded by the European Commission. Key action 3 means that it is a project meant to support policy development and cooperation. It started in 2021 and will end in January 2024. 17 partners from 5 countries (in alphabetical order): France, Ireland, Italy, Luxemburg and Slovenia are involved, including education ministries, research labs, and independent evaluators. In Italy, the evaluator is Indire (Istituto nazionale documentazione innovazione ricerca educativa).

- What is AI4T about?(8)

The goal of AI4T is to 1) develop a training course to help secondary school teachers understand and use AI tools, and 2) evaluate the impact of the project through survey and field observations, to provide guidance for policy makers regarding AI in education.

The main target of the project is the teachers. We recruited mainly math and language teachers (but also a few other teachers in STEM), who teach 15/16-year-old students. We also involved school leaders in the project as we believed that school leaders were fundamental to create dynamics of change in the schools.

The key objectives of the training course are :

- Understanding basic AI;
- Discovering of AI tools for education;
- Discovering non education directed tools also influencing education;
- Questioning the direct and indirect effects of AI on education.

- Timeline + administration period (9)

The first phase of the project was the pilot phase conducted in 2021-2022, where we tested the experimentation protocol on a few schools in each country. In 2022-2023 we implemented the full-scale experimentation in about 300 schools.

- Teacher baseline - participants & administration periods (10)

We sent a baseline questionnaire to all participants before some of them received the training. We received 952 answers in total including 383 answers from math teachers. As you can see, for different reasons, the administration period for the questionnaire was different depending on the country. In Italy the questionnaire was administered a little bit later, so we may have a "ChatGPT" effect on the responses, considering that ChatGPT 3 was launched at the end of November 2023. Note that the existence of a control group is very important in this situation.

As the number of teachers, and even more so the number of mathematics teachers, is low in Ireland and Luxembourg, I'm focusing my presentation on 3 countries: France, Italy and Slovenia. Note that the total numbers of teachers include Ireland and Luxembourg.

I will present here the results of the baseline questionnaire. It's an initial picture of teachers' perceptions of AI. The complete evaluation will be presented on January 2024. I've tried to do my best to make the tables readable for you, and I hope that will be the case!

- A few information on the sample (11)

There are 68 % of female and 47 % with 20 or more years of experience. As you can see if you look at the proportion of women in the different of country, it is not equally distributed. The samples are not similar in each country so we should be careful when we make comparisons. The distribution of teachers by subject is also different. This is an important point. Differences between countries could be due to many factors including simply differences in samples or differences in response style (we know that when we ask people to answer on a scale, depending on their culture they may be more inclined to choose extreme anchor points or central anchor points).

- Types of schools (12)

We recruited both academic and vocational secondary schools. You can see here the percentages of teachers per type of schools in France, Italy and Slovenia.

- Self-efficacy using digital technologies (13)

We also begin the questionnaire with a few questions on the use of digital tools by the teachers and their self-efficacy using digital technologies for teaching and learning. You can see that 91 % of teachers agree with the statement "I feel confident I can consistently use educational digital technologies in effective ways". The high percentages in this section show that we have a sample of teachers who are confident when they use digital technologies. It's important to know that all the teachers in the sample volunteered to participate in an AI project.

- Students' use of digital technologies (14)

On this slide we see that 61 % of teachers ask their students to use digital technologies at least once a week, and only 50 % of maths teachers.

- Comparisons with TALIS results (15)

If we compare with figures from the OECD, the percentage of teachers who let their students use digital technologies regularly is a bit lower, except for maths Slovenian teachers. It's 36,1 % in France, 46,6 % in Italy and 36,5 % in Slovenia. Self-efficacy using digital technologies seem higher in our sample than in the general population. In the TALIS results, 45 % of French teachers and 79 % of Italian teachers say that they can support student learning through the use of digital technologies "quite a bit" or "a lot". However, these differences may also be linked to the fact that the TALIS data concern lower secondary teachers.

- AI4T results (17)

Now that we have these considerations in mind, let's look at the results from the baseline questionnaire. I will first talk about teachers' understanding of AI, then their use and finally their perceptions.

- **Teachers' understanding of AI (18)**

We first asked teachers to rate their own knowledge of AI. We see that 38,6 % declare that their knowledge is rather poor and 35,4 % that their knowledge is rather good. A lot of teachers chose the central options. They consider that they have a moderate understanding and knowledge of AI. It's the same for maths teachers.

- Not familiar with technical aspects (19)

They also indicate that they are not familiar with technical aspects of AI, such as machine learning, deep learning or supervised learning. Only 38 % of teachers say that they are at least rather familiar with machine learning, and it's lower for deep learning and supervised learning.

- The difficulty of identifying AI tools (20)

Finally, we see that their knowledge of AI isn't based on concrete tools for education. Only 54,5 % of teachers said that they could give an example of an AI tool for education. Among them, many mentioned digital technologies that do not seem to contain AI.

Here we tried to understand which technology they think about when we say AI. We see that 76 % of teachers would identify automatic translators as AI, but also that 25 % would think that spreadsheets fall under the umbrella of AI.

- Defining AI (21)

Actually, identifying which tools contain or do not contain AI is difficult, not only for teachers but also for experts. First, because AI is an umbrella term. Artificial intelligence is an ambition. Marvin Minsky, one of the father of AI, described it in 1968 as "*the science of making machine do things that would require intelligence if done by men".* There is subjectivity in defining what is considered as intelligent. The term covers a wide range of technologies ranging from expert systems, which was the main AI technology in the 80s, to machine learning nowadays. There is no official taxonomy of which technology is or isn't AI.

Moreover, users do not have access to how a software is designed and which technology it is based on. Private companies do not share their secrets. When I

heard that for the first time, I thought of the Italian mathematicians of the 16th century, as Tartaglia, who kept as well their secrets to earn their life.

Thus, it is important to note that, when teachers answer questions about their use and perceptions of AI, they don't have the same technologies in mind.

- Teachers' use of AI (23)

Most teachers declare that they don't use AI regularly. About 39 % of teachers (47 % of maths teachers) say that they never use educational AI tools to teach, and 20 % that they use them less than once a month.

- Teachers' use of AI (24)

When asked about generic AI tools, so tools that weren't specifically designed for education, we have 34 % of teachers (46 % of maths teachers) who declare that they never use them, 20 % who say that they use them less than once a month.

- Students' use of AI (25)

Not surprisingly, these percentages fall down when we look at the use of AI by students. Around 41 % of teachers (49 % of maths teachers) say that they never ask their students to use educational AI tools and 23 % ask their students to use them less than once a month.

- Students' use of AI (26)

Concerning generic AI tools, it's a little bit different, probably because of language teachers. Around 35 % of teachers (47 % of maths teachers) say that they never ask their students to use generic AI tools and 24 % ask their students to use them less than once a month.

- Only maths teacher (27)

We questioned them on specific tools that we know contain AI. We see that for generic tools such as search engines, 80 % of teachers declare using them. On the other hand, when asked about specific educational AI tools, very few teachers say that they use them, with the exception of Photomath, half of

Slovenian teachers and a quarter of Italian teachers say that they have asked their students to use it.

- Teachers' use of AI : types of use (28)

For those who declare using AI tools, we asked them about how they use them. While 84 % of teachers declare using them to create/present/share content, only about 12 % say that they use them to diagnose students' mistakes and misconceptions. More advanced use of AI technologies is less common.

- Teachers' use of AI : ethical consciouness (29)

The last point I'd like to raise with you is the ethical dimension, which is very important when we talk about AI. Even if only 14 % of teachers declare that they are never alert to privacy and information security issues when using AI tools, about two teachers out of three declare that they have a good understanding of the ethical issues, that they always comply with ethical principles or they always alert to the abuse of AI technology when using AI tools**.**

- Teachers' use of AI : Intentions of use (30)

Finally, we see that more than 90 % of teachers in the sample have the intention of using AI…. which is not very amazing!

We can question now why most teachers in the sample do not already use AI regularly.

- Teachers' affects enjoyement(31)

If we look at teacher's enjoyment, we see that about 90 % of them agree with the statement "The challenge of learning about AI is exciting", "I enjoy or would enjoy using AI tools", Using AI tools is/would be stimulating. Unsurprisingly, this percentage drops when teachers are asked about student use, but remains very high (nearly 80 %)

On the other hand, only 13 % agree that "using AI tools makes or would make them anxious" and "Conducting class sessions in which my students use AI tools makes/would make me anxious". Even fewer maths teachers seem to report anxiety about AI.

Unlike what we thought at the beginning, we don't see a general apprehension to use AI, and their main worries seem to be applicable to any type of digital technologies. For example, 26 % of teachers are afraid that AI tools will malfunction while they use them.

Please note that the two answer options "I'm afraid of making mistakes if I use an AI tool" and "I'm afraid that AI tool while malfunction when I or my students use them" were added following feedbacks from teachers during the pilot phase.

- Emotions associated with AI (Open question) (33)

We asked through an open question what emotion teachers associate with AI and half of them mentioned emotions that we classified in the category "drawn to AI". They mentioned curiosity, excitement, hope, etc.

➔ An apprehension or lack of enthusiasm doesn't seem to be the reason why most teachers do not use AI regularly. So we have to look for other factors.

- Teachers' perceived ease of use of AI (34)

Maybe teachers perceive AI as being hard to use? Not so much either. 69 % of them agree with the statement "it would be easy for me to become skillfull at using AI tools".

- Teachers' perceived utility (35)

Teachers seems also very enthusiastic about the utility of AI. If we add up the 3 "agree" options, there are almost 90 % of teachers who agree that AI would be useful in their work.

- Citation (36)

But it is important to nuance this figure. This is only a general perception, it doesn't mean that they believe that AI is always useful, as we can see with this quote from one of the French math teachers who participated in the project: "*I think AI is a tool. Like all tools, they have great applications and there are times when they are used for absolutely no purpose, because they don't add any value. Like all tools, you have to use them sensibly.*"

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- Perceived utility for specific functions (37)

If we ask them about the utility of AI for specific functions, we see a variation in the answers. While 88 % of teachers agree that AI tools would be useful to create content, only 59 % think that it would help to answer students' questions.

- Teachers' beliefs(38)

Finally, we wondered if there were some specific beliefs that would lead teachers to refuse to use AI. We see here that teachers tend to agree with positive statements such as "AI would increase teaching quality" or "with AI teaching will be more personalised to student needs". Concerns over being replaced by AI, or AI leading to a dehumanisation of education are not very present in our sample. The concerns which obtained the highest percentages are privacy issues or the influence of private companies.

- Perspectives (39)

We see a general enthusiasm about AI throughout the questionnaire, and yet even in this sample of volunteers, there isn't a high and regular use of AI. To explain this, we need to consider other factors. In particular, one difficulty that we encountered in the project is the availability of AI tools for secondary teachers, and specially for maths teachers.

- Citation (40)

In France we gave mathematics teachers free access to an AI tool called Kwyk. As this French mathematics teacher mentioned, one of the drawback for him was that he wouldn't have access to the tool next year because his school wouldn't pay the fee. He also criticized the fact that the tool wasn't adapted to the curriculum in vocational schools.

It is hard to find tools that are 1) adapted to the level and the subject of the teachers, 2) that are based on real AI technologies and 3) that are free.

On the other hand, generic AI tools such as chat GPT which was suggested to language teachers led to other issues. Many teachers did not encourage their students to use the tools because it was not GDPR compliant.

- Conclusion(41)

To conclude, a lot of teachers that have participated to the project did not have a concrete experience of using educational AI tools, even if they were volunteers and even if they are rather familiar with digital tools. Many of them can’t name an AI tool that they could be used for educational purpose. They also have a hard time identifying when AI is present in a tool.

Therefore, there isn’t necessarily a shift between teachers’ use and perception of digital technologies and their use and perception of AI.

When designing teacher training about AI, we usually reach the early adopters, the ones who are the most enthusiastic about using the technology. However, even for them the step towards using AI was hindered by the availability of good AI tools adapted for their situation. It is important that more tools are being developed with the specific objective to answer teachers’ needs. It is also important that research is being carried on how AI tools can be best used in the classroom to ensure that it brings added value to students. Especially with the boom of generative AI. New tools such as chat GPT or Dali are being put on the market. Some teachers among early adopters are already showing that it is possible to innovate with these tools and integrate them in the school. Let's share these experiences so that teachers and pupils can benefit from them and let's encourage research on these news practices.

- Citation (42)

And I will end my presentation by a feedback of a French teacher that makes much sense for me !