



International Forum 2023

AI: From Industry and Research to TVET Sector

Pedagogical issues
Examples in Computer Science and in Mathematics

RIGA - Latvia

secretariat@skillman.eu

Bernard DUMONT

Consulting

bdumont.consultant@gmail.com



Co-funded by the
Erasmus+ Programme
of the European Union



Co-funded by
the European Union

AI Tools from Research and Industry

- Powerful AI tools are developed by human beings for human beings. They should be seen in TVET as an opportunity, not a threat.
- They are developed for other purposes than education, but they exist and are very easy to access and use, and more or less cheap to access.
- How to use these new AI tools as aids to learning, understanding complex phenomena and memorization ?
 - Learning Management Systems are taken advantages from AI tools to improve the quality of the learning activities of the students, for instance adaptive learning (Customized learning paths), intelligent recommendations for personalized content suggestions, natural language processing for queries
 - AI-powered language translation and pronunciation tools can aid speakers in learning technical terms and improving their communication skills in other languages than their mother tongue.
 - AI-powered spaced repetition apps can optimize students' memorization process: they are based on algorithms to schedule review sessions for information they need to retain, enhancing long-term memory.
 - More generally, using AI conversational agents such as ChatGPT provide multiple aids in training...
 - ...but it raises some pedagogical issues.

The specificity of TVET

- AI-driven simulations and virtual laboratories can provide students with hands-on experience of complex phenomena in a safe and controlled environment. This is especially valuable for technical and vocational training, where real-world equipment and materials can be expensive or dangerous.
- AI can offer career counseling and guidance based on a student's skills, interests, and job market trends. This helps students make informed decisions about their career paths.
- AI can help TVET institutions collaborate more effectively with industry partners. For example, AI can facilitate the exchange of real-world industry data and trends to inform curriculum development.
- *Last news:*
 - *Amazon invests \$4 billions in Anthropic, an AI start-up developing a competitor of ChatGPT.*
 - *Marc Zuckerberg announces META AI to be available in Facebook, WhatsApp, Instagram...*

AI for Computer Science & Mathematics (1)

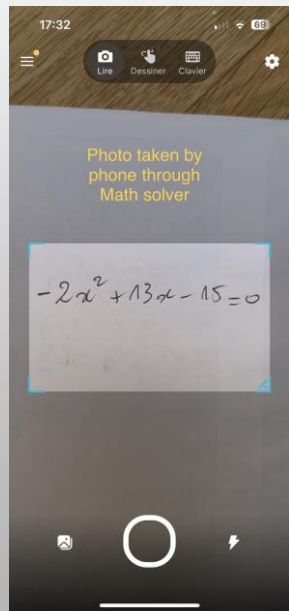
- Both sciences can easily take advantage of AI as they are using very codified rules (cf. first years of AI with chess programs) but the new features are:
 - One can describe the problem in ordinary language or even taking a picture of a hand written problem
 - The user receives, not only the solution, but also explanations about the methodology / methodologies to solve the problem
- Many tools are already available online or as apps for instance:
 - AI coding assistants as Codeium or Copilot
 - AI aids for problem solving as Math Solver (Microsoft) or Mathway (Chegg)

AI for Computer Science & Mathematics (2)

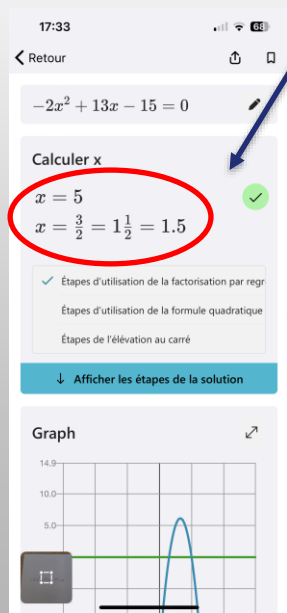
- Many tools are already available online or as apps
 - AI coding assistants as Codeium or Copilot
 - AI aids for problem solving as Math Solver (Microsoft) or Mathway (Chegg)
 - These tools available online and on smartphones are able to understand and solve a question even in hand-writing, taking a picture of it.
- Example with Math Solver: question based on a hand-written equation

AI for Computer Science & Mathematics (3)

- Example with Math Solver: question based on a hand-written equation



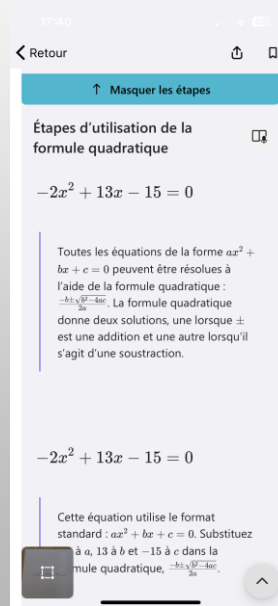
Even with poorly written numbers (like the 5) the apps correctly interprets my equation.



Here are the two solutions.

Interesting remark:
The second one is given in 3 different forms.

It is possible to choose the method to be developed ...



... and then get the explanation step by step



On top of it, some videos are recommended to reinforce the understanding

Pedagogical issues: examples with ChatGPT (1)

In Computer Science

One can ask ChatGPT, in a « natural » way to write a programme in a given language.

Write a program in html that displays for 20 seconds successively an image among a set of 10 photos

Solution obtained in less than 20 s.

<https://chat.openai.com/share/4c8af895-5ef4-479a-b222-d3bb6f8441ad>

Pedagogical issues: examples with ChatGPT (2)

In Computer Science

ChatGPT gives the requested programme but also useful information that can help an user or a student.

To create an HTML program that successively displays one image from a set of 10 photos for 20 seconds, you can use JavaScript to handle the slideshow logic. Here is an example of HTML, CSS and JavaScript code to do this:



ChatGPT is rephrasing my request, but adding that it will use also CSS and JavaScript code.


```
html Copy code
<!DOCTYPE html>
<html>
<head>
<meta charset="UTF-8">
<title>Diaporama</title>
<style>
#slideshow {
max-width: 100%;
max-height: 100%;
}
</style>
</head>
</body>
<div id="slideshow">










</div>
<script>
var images = document.querySelectorAll("#slideshow img");
var currentIndex = 0;

function showImage(index) {
for (var i = 0; i < images.length; i++) {
images[i].style.display = 'none';
}
images[index].style.display = 'block';
}

function nextImage() {
currentIndex = (currentIndex + 1) % images.length;
showImage(currentIndex);
}

setInterval(nextImage, 2000); // Change image toutes les 2 secondes (2)
</script>
</body>
</html>
```

Make sure to replace "image1.jpg", "image2.jpg", etc., with the actual paths of your 10 images. This code displays images one after the other every 2 seconds (2000 ms) and returns to the beginning when all images have been displayed. You can adjust the duration of the image change by changing the value of set Interval(in milliseconds). In the example above, it is set to 2000 ms, or 2 seconds. For 20 seconds you will need to set set Interval to 20000 (20,000 ms).

ChatGPT is explaining what to do with the user's images.

But more interesting: the given code does not answer exactly my request! It has changed the interval from 20 s to 2 s. That is a good suggestion as in fact it is very long for a slideshow to wait 20 s in front of the same image.

Nevertheless, ChatGPT explains what I would have to do to go back to 20 s if I really want this time.



Regenerate

Pedagogical issues: examples with ChatGPT (3)

In Mathematics

One can ask ChatGPT, also in a « natural » way, to solve a problem, like this one:

Find a polynomial function of the 3rd degree passing through the points A (5; 2), B (1; -1), C (2; 0) and D(0; 3)

Solution obtained in less than 25 s.

$$f(x) = -\frac{7}{360}x^3 + \frac{59}{120}x^2 + \frac{109}{120}x + 3$$

<https://chat.openai.com/share/521bd226-fef7-49c3-87a4-cd6d0ad93ebe>

ChatGPT writes the answer with the usual mathematical notation and gives several clues about the method to be followed and is developing the calculus until the end.

Pedagogical issues: examples with ChatGPT (4)

In Mathematics

$$f(x) = -\frac{7}{360}x^3 + \frac{59}{120}x^2 + \frac{109}{120}x + 3$$

But this function does not pass through all the 4 given points!

It is easy to notice that, looking at the point C (2;0), but where is the mistake?

So ChatGPT is able to describe a correct method and to use it, but as some good students who sometimes are going too fast, it can make errors (of inattention?), in this case an error of sign.

It would have been interesting to continue the discussion with ChatGPT, asking it for instance: Where is your mistake? Or: Check if C(2;0) is on the graph of this function.

$$-8a + 4b - 2c + 3 + (a + b + c + 3) = 0 - 1$$

Cela donne :

$$-7a + 5b + c = -1$$

Pedagogical issues: examples with ChatGPT (5)

In Mathematics

But this function does not pass through all the 4 given points!

It would have been interesting to continue the discussion with ChatGPT, asking it for instance:

- Where is your mistake?
- Or: Check if $C(2;0)$ is on the graph of this function.

This kind of interaction with ChatGPT could give to teachers a lot of opportunities to work with their students on mathematical issues but also on the advantages AND the limitations of such conversational tools.

Pedagogical issues

- Even if ChatGPT produces credible answers, it can make mistakes, invent facts, events... so it is important when using this kind of tools:
 - To train students in critical thinking
 - To develop their ability to verify facts
- Assessment strategies need to take into account such tools
- If students have access to AI tools:
 - Focus on higher-order thinking skills and understanding rather than rote memorization.
 - Use questions (e. g. open-ended questions) that require critical thinking, analysis, and synthesis of information.
 - Use performance-based assessments – especially in TVET - as hands-on projects, presentations, debates...
- But also you can restrict the use of AI tools during certain assessments to ensure that students are primarily relying on their own knowledge and skills.

SWOT analysis, by ChatGPT: the use of AI by teachers in TVET

- I asked ChatGPT to make a SWOT analysis. This is presented in the four next slides. Everything is relevant even if it is not at the same level of interest. Two similar points are found in strengths and opportunities (about learning personalization).
- Nevertheless, this could be used as a good start for a brainstorming within a TVET institution, between teachers, administrative staff and stakeholders (industrial partners, chambers of commerce and industry, governmental representatives...).
- After this analysis, and to conclude, I suggest some recommendations for the different stakeholders.

Strengths

- **Enhanced Personalization:** AI can analyze individual learning patterns and adapt teaching materials to cater to the specific needs and learning styles of each student.
- **Efficiency:** AI can automate administrative tasks, allowing teachers to focus more on actual teaching and mentoring, improving overall productivity.
- **Access to Resources:** AI can provide teachers with access to vast repositories of educational materials, including digital textbooks, videos, and interactive simulations, enriching the learning experience.
- **Real-time Feedback:** AI-powered assessment tools can provide instant feedback to students, enabling them to identify and address their weaknesses immediately.
- **Data-Driven Decision-Making:** AI can process and analyze large volumes of data to help educators make informed decisions about curriculum design and teaching methods.

Weaknesses

- **Lack of Human Touch:** Overreliance on AI may lead to a reduction in human interaction and the emotional support that teachers can provide, which is crucial in education.
- **Cost and Infrastructure:** Implementing AI in TVET may require significant financial investments in technology and training, which some institutions may not afford.
- **Privacy Concerns:** AI systems collect and process student data, raising privacy concerns about how this information is stored, used, and protected.
- **Technical Challenges:** Technical issues like system failures or data breaches could disrupt the learning process and undermine the credibility of AI in education.
- **Content Relevance:** AI-driven recommendations and personalized content may not always align with the curriculum's goals or educational standards.

Opportunities

- Customized Learning Paths: AI can create personalized learning paths for students, accommodating various learning paces and abilities.
- Global Reach: Online AI-driven education can reach students in remote areas, expanding access to TVET programs worldwide.
- Continuous Improvement: AI can help in continuously improving teaching methods and materials by analyzing data on student performance and feedback.
- Skills Development: AI can be used to teach students valuable skills in AI and technology, preparing them for the job market.
- Innovative Pedagogy: AI can enable the development of new and innovative teaching methods, making learning more engaging and effective.

Threats

- **Job Displacement:** Concerns about AI replacing human teachers may create resistance to its adoption.
- **Inequality:** Students who lack access to AI-powered resources may be left behind, exacerbating educational inequalities.
- **Bias and Discrimination:** AI algorithms may inherit biases present in the data used for training, potentially leading to unfair treatment of certain student groups.
- **Dependence on Technology:** Overreliance on AI can make the education system vulnerable to technical glitches, cyberattacks, and disruptions.
- **Ethical Concerns:** Decisions made by AI in education, such as personalized content recommendations, may raise ethical questions about privacy and manipulation.

Some recommendations

For curriculum designers:

- Conduct a needs and trends analysis to identify the specific skills and knowledge related to AI that are in demand within the job market and industries relevant to TVET programs.
- Align the learning objectives with industry standards and best practices in AI.
- Don't concentrate AI in specialized courses but integrate it in all relevant disciplines, general ones (languages, mathematics, sciences) as well as TVET ones (robotics, automation, data analysis, cybersecurity, design, ...).
- Collaborate with industry and professional partners to develop and update the curriculum.
- Ensure a continuous evaluation and improvement process of the curriculum.

Some recommendations

For TVET training institutions:

- Develop a vision and a strategy for integrating AI into programs.
- Train teachers and staff in AI concepts and technologies.
- Train teachers in how to integrate AI in their discipline and in their teaching methods.
- Be sure that everyone is aware of the potential and of the constraints of using AI in training, and that no one is left on the side of the road.
- Ensure that the curriculum includes both theoretical knowledge and hands-on practical experience with AI tools and technologies, while considering accessibility and inclusivity.
- Allocate resources for acquiring AI-specific hardware, software, and infrastructure as AI labs or facilities for students.
- Encourage interdisciplinary collaboration by creating opportunities for students from various TVET disciplines to work together on projects including AI.

Some recommendations

- **For teachers:**

- Adapt the curriculum to include AI-related content and projects that align with their specific discipline, using as much as possible real-world examples and case studies to illustrate AI concepts. Seek regular feedback from students to make continuous improvements.
- Foster connections with professionals in industry, and other sectors related to their disciplines, who can provide practical insights into AI applications.
- Use real-world examples and case studies to illustrate AI concepts and applications in a context relevant to their disciplines.
- Promote critical thinking and problem-solving skills by assigning AI-related projects that require students to analyze, design, and implement AI solutions.
- Incorporate discussions about the ethical implications of AI, including bias, privacy, and responsible AI development and usage.
- Adjust evaluation strategies, with particular assessments conducted with AI tools available to students and others without,
- Join AI education communities and networks to connect with other educators, share best practices, and access resources for AI teaching, especially in their disciplines.



International Forum 2023

RIGA - Latvia

secretariat@skillman.eu

Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Commission. Neither the European Union nor the granting authority can be held responsible for them.

Author

Bernard DUMONT

6 rue des sonneurs F-34990 JUVIGNAC

bdumont.consultant@gmail.com

www.bdumont-consultant.fr



Co-funded by the
Erasmus+ Programme
of the European Union



Co-funded by
the European Union