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Professional paper

Teaching French for Science through Student Engagement in a Scientific Mediation Program

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Abstract: *This paper introduces a project-based French language program that integrates linguistic and scientific mediations, specifically designed for B2-level science students. Implemented at Imperial College London in 2018, the initiative aimed to enhance students' proficiency in French within a scientific framework while fostering interdisciplinary collaboration. The program involved twenty-four students from diverse scientific disciplines—including mathematics, physics, biology, aeronautics, civil engineering, biochemistry, chemistry, and chemical engineering—organized into interdisciplinary workgroups. Their objectives encompassed investigating and exchanging knowledge across their different fields on challenging phenomena such as climate change, the origin of life, and protein folding, employing effective mediation strategies to facilitate understanding of these phenomena and to collaboratively produce a scientific poster presenting their findings to address them.*

Key words: *Project-based learning, French for Science, scientific mediation, linguistic mediation, collaborative approach, interdisciplinary work*

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1. Introduction

How to teach French to science students for practical and professional purposes? Traditionally, specialized language programs rely on the study of disciplinary texts[1] , with the aim of familiarizing learners with the specific discourse genres and vocabulary pertinent to their field of study. As Besse (1985) notes, "the primary objective is to rapidly develop reading competence in L2 texts related to the specialty or the specific interests of the target audience."[2] However, within the university setting, this type of course does not fully capitalize on students' potential within their respective fields nor sufficiently prepare them to join international research teams. These teams are tasked with actively contributing to the expansion of knowledge, fostering innovation, and solving complex problems often related to social, economic, or environmental challenges.

With this in mind, as a French teacher at the Centre for Languages, Cultures, and Communication at Imperial College London, I embarked on designing a task-based French learning program for science (Ellis, 2003) that addresses students' communication needs in professional and research contexts. The aim was to promote active engagement within an interdisciplinary team tasked with tackling a global challenge. This idea was inspired by the project developed by Dr. Elizabeth Hauke, Principal Teaching Fellow at the Centre for Languages, Cultures, and Communication, who launched the Change Makers module (formerly Global Challenges) in 2012 as part of Imperial Horizons.

Given the disciplinary diversity of the students[3] , this learning program could only rely on an action-oriented communicative approach emphasizing mediation skills (North & Piccardo, 2016). First, students would need to conduct investigation work on the problem at hand, which involves reading articles and watching specialized programs in both French and English, as well as processing data through various discursive transformations, such as translation, summarization, and synthesis. Second, they would have to share information with their team, composed of students from different disciplines, necessitating mediation that includes interlinguistic dimensions (interpreting a text in L2

[1] A long-standing approach at Imperial College London for teaching language for scientific purposes involved a language course based on the translation of scientific articles. I taught such a course for two years, which revealed that many students showed limited motivation to work with texts unrelated to their respective fields, reflecting a somewhat compartmentalized perception of science.
[2] Exerpt in French in Henri Besse's book : « Il s'agit principalement de développer rapidement une compétence de lecture de textes en L2 relevant de la spécialité ou des intérêts spécifiques du public auquel on s'adresse. »
[3] This pilot project involved 26 undergraduate students, primarily at the B2 level in French, from eight scientific disciplines (biochemistry, chemistry, physics, civil engineering, aeronautics, mathematics, biology, and chemical engineering). More specifically, the cohort participating in this project consisted of 21 first-year students, four second-year students, and one third-year student.

into L1, explaining an L1 concept in L2) as well as intralinguistic dimensions (summarizing an L2 text in L2), thereby requiring management of collaborative interaction. Thus, this activity of (re)processing an existing text "integrates and goes further than the co-construction of meaning by underlining the constant link between the social and individual dimensions in language use and language learning" (North & Piccardo, 2016: 9).

To achieve this, students needed to leverage their individual knowledge and interests: they were thus encouraged to mobilize their scientific and linguistic skills in French to understand phenomena, consider solutions, and share innovative perspectives. This program also aimed to train students in research practices while developing methodological rigor, critical thinking, and reflexivity.

In this article, I will present the French for Science program implemented in 2018-2019 at Imperial College London. The program was structured into four modules, spread over eighteen face-to-face and mediated sessions conducted via the Confluence wiki platform, which was used to create a multimedia collaborative learning environment. The program began with a phase of awareness-raising about the course (Module 1), followed by data collection and scientific inquiry (Module 2). It then focused on the methodology for developing scientific posters (Module 3), culminating in the oral presentation of each group's discoveries and solutions (Module 4) in the form of science communication aimed at a broader audience.

2. Module 1: Raising Students' Awareness of a Complex Scientific Phenomenon and the Benefits of Interdisciplinary Collaboration in Its Comprehension

The initial module comprised four one-hour sessions. Its primary objective was to enhance students' awareness of a specific scientific phenomenon and to highlight the advantages of interdisciplinary teamwork in understanding such complex issues. To initiate the module, I displayed two articles on the classroom walls, extracted from *Felix* (Issue No. 1676, November 2017, and Issue No. 1693, May 2018), which is Imperial's student newspaper, founded in 1949. These articles bore compelling titles: "Imperial sinks to the bottom of People & Planet's ethical league tables" and "Imperial emitted more CO2 than any other university in the UK last year." These provocative headlines elicited immediate reactions: some students expressed shock that their esteemed university ranked poorly in terms of environmental responsibility; others defended the institution, perceiving the articles as unfair attacks on its reputation; while a few participants were distressed that their university was being unjustly accused. These initial reactions underscored the necessity of deeper exploration of the issue of climate change.

Accordingly, I tasked students with reading the conclusion of the IPCC (Intergovernmental Panel on Climate Change), known as GIEC in French (Groupe d'experts intergouvernemental sur l'évolution du climat), published in French on October 8, 2018, in an article from *Le Monde* titled *Ce qu'il faut retenir du rapport du GIEC sur la hausse globale des températures* ("Key takeaways from the IPCC report on global temperature rise"). Subsequently, students analyzed and discussed nine graphs presented in the document *"The World Scientists' Warning to Humanity: A Second Notice,"* signed by over 15,000 scientists. This report served as a stark wake-up call, emphasizing the crucial role of science and scientists within society.

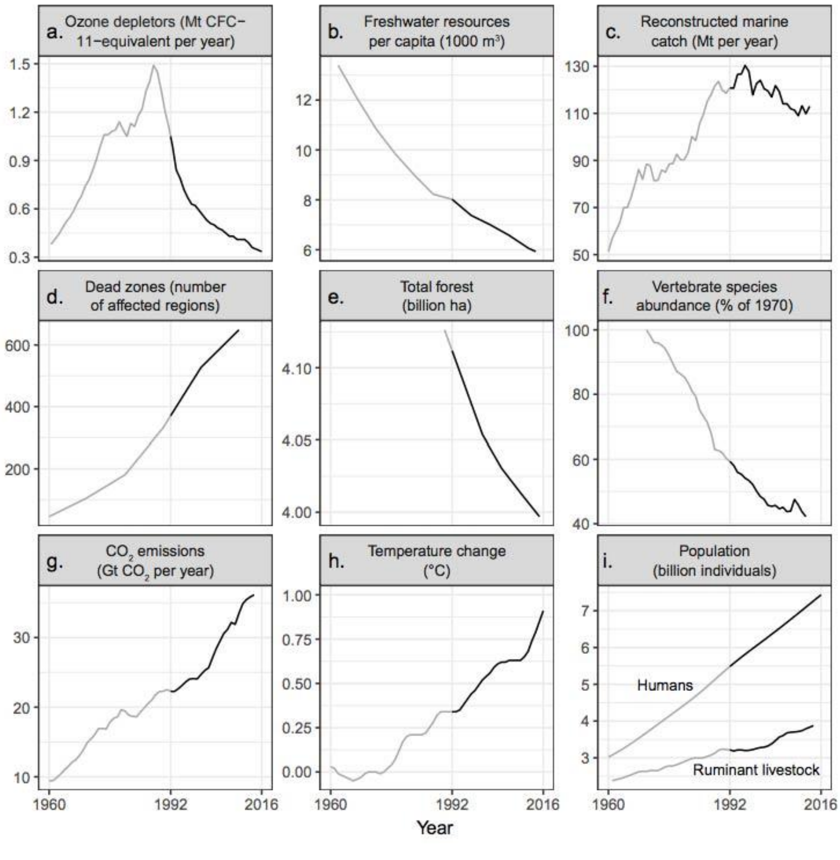

Figure 2.1 Published in BioScience, *Volume 67, Issue 12, December 2017, Pages 1026–1028,* https://doi.org/10.1093/biosci/bix125, *captioned as followed*

"Figure 2.1. Trends over time for environmental issues identified in the 1992 scientists' warning to humanity. The years before and after the 1992 scientists' warning are shown as gray and black lines, respectively. Panel (a) shows emissions of halogen source gases, which deplete stratospheric ozone, assuming a constant natural emission rate of 0.11 Mt CFC-11-equivalent per year. In panel (c), marine catch has been going down since the mid-1990s, but at the same time, fishing effort has been going up (supplemental file S1). The vertebrate abundance index in panel (f) has been adjusted for taxonomic and geographic bias but incorporates relatively little data from developing countries, where there are the fewest studies; between 1970 and 2012, vertebrates declined by 58 percent, with freshwater, marine, and terrestrial populations declining by 81, 36, and 35 percent, respectively (file S1). Five-year means are shown in panel (h). In panel (i), ruminant livestock consist of domestic cattle, sheep, goats, and buffaloes. Note that y-axes do not start at zero, and it is important to inspect the data range when interpreting each graph. Percentage change, since 1992, for the variables in each panel are as follows: (a) –68.1%; (b) –26.1%; (c) –6.4%; (d) +75.3%; (e) –2.8%; (f) – 28.9%; (g) +62.1%; (h) +167.6%; and (i) humans: +35.5%, ruminant livestock: +20.5%."

Despite engaging discussion and debate, students initially perceived their role in addressing such global issues as limited and regarded themselves as powerless. In response, I introduced an excerpt from the *Manifesto for an Ecological Wake-Up Call*[4], disseminated in October 2018 by French students from various leading engineering and business schools—including École Polytechnique, HEC (Hautes Études Commerciales), ENS (École Normale Supérieure), and INRA (Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement). In this manifesto, students advocate as active citizens, asserting their intention to select future employers based on their ecological commitments.

This reading was crucial in changing their perspective and motivating them to take action, which they did by writing a manifesto in French encouraging other students to adopt responsible and sustainable practices concerning water, food, and energy consumption.

Building on this, I proposed a second activity: participation in a scientific research project to explore a complex scientific phenomenon of their choice. The next step was to organize ourselves and develop a working method. The inspiration for this came from a critical reading of the interview with John Hennessy—former president of Stanford University (California)—published in *Le Monde* in March 2016[5]. In the interview, he highlighted the advantage of interdisciplinarity in addressing the most complex problems, which convinced the students to adopt this strategy.

[4] https://manifeste.pour-un-reveil-ecologique.org/fr
[5] Belot Laure & Davidenkoff Emmanuel. (2016). " John Hennessy : Le défi majeur est d'apprendre à apprendre tout au long de la vie ". Available on *Le Monde* : https://www.lemonde.fr/campus/article/2016/03/03/john-hennessy-nous-sommes-bien-incapables-d-enseigner-aux-jeunes-ce-qu-ils-devront-savoir-dans-dix-ans_4875624_4401467.html

Thus, students divided into seven interdisciplinary groups, each consisting of three or four participants. Each group chose different topics, including resource depletion, climate change, plastic pollution, the origins of the universe and life, and protein folding modelling (which has become a significant global health concern). Some groups opted to focus on the same phenomenon, resulting in two teams investigating, for example, carbon emission reduction. Notably, the composition of the groups allowed each student to contribute their specialized knowledge from their respective fields—such as physics, biology, chemistry, aeronautics, mathematics, chemical engineering, and biochemistry—and to collaboratively share insights and expertise within the group.

Aiming to maintain their motivation (Dörnyei, 2001), the group work focused on two main tasks: an interdisciplinary scientific poster and a science presentation, to be delivered at the culmination of their research projects.

3. Module 2: Data Collection and Scientific Inquiry

Module 2 comprised five sessions. To sustain students' motivation and engagement, I adopted the pedagogical strategy of positioning each student as an expert within their respective discipline. Consequently, students were tasked with collecting data relevant to their assigned topics, including identifying theories, explanations, experiments, and key findings. To facilitate this process, each group was provided access to a Confluence wiki, a collaborative knowledge-sharing platform that allows users to modify content and structure directly via their web browser. As most students were unfamiliar with this system—except one—I helped them to acquire basic navigational skills to effectively utilize it.

Then, to initiate their investigations, I supplied each group with a selection of scientific articles in French relevant to their disciplines and topics. For instance, the group focusing on climate change and carbon reduction was encouraged to explore research by Thibault Cantat, a CNRS (Centre National de la Recherche Scientifique) scientist working on carbon recycling, while the biology-focused group examined the work of Delphine Barbier from INRAP (Institut National de Recherches Archéologiques Préventives) specializing in palynology.

Some of these students were surprised to discover that there are scientific articles written in French, as they had generally assumed that scientists only publish their work in English, considering it the sole dominant language of scientific discourse. This realization prompted some participants to appreciate the potential of French to broaden their opportunities for scientific reading and engagement.

Throughout the subsequent lessons, students investigated their topics further by gathering additional data from videos, articles, websites, and online conferences—in both English and French—and shared their findings with their peers, predominantly in French. For example, a biochemistry student in the carbon reduction group explained the process of artificial photosynthesis, while another presented the ANSAT project—a satellite system capable of generating maps illustrating carbon concentrations by country.

This module proved to be particularly challenging for students, as they were required to critically process data and organize their work methodologically, while simultaneously developing a deep understanding of the phenomenon they chose to explore. This module entailed the following requirements:

- Read, comprehend, and explain to peers the scientific documents collected
- Summarize these texts in French
- Select appropriate illustrations for their posters
- Engage in discussions with colleagues to assess their relevance for inclusion in the poster
- Compile a glossary of unfamiliar French scientific terms
- Initiate the creation of references and bibliographies
- Write a report summarizing each session

To optimize efficiency, role assignments were established at the beginning of each session. Consequently, data collection involved transforming raw information into various formats integrating reading, listening, speaking, and writing skills into a cohesive series of communicative activities (Mourlhon-Dallies, 2008: 92) mirroring professional practices. This approach involved the dual mediation (Patchareerat, 2018) of conveying scientific knowledge in a language other than the students' first language

During this stage, some students encountered significant difficulties: two students chose to withdraw from the course rather than depend on their group members. Additionally, four students expressed dissatisfaction with a course structure that did not position the teacher as the central authority of knowledge and mediation. It is true that interdisciplinary education (De Greef et al., 2017) entails a shift in the educational culture, as the teacher does not position themselves as a disciplinary expert but rather as a facilitator of learning and independent research, engaging in co-learning with students.

Nevertheless, the majority—twenty students—remained highly motivated and committed to continuing the program.

4. Module 3: Design and Creation of Scientific Posters

The third module comprised five sessions, with the primary aim of guiding students through the process of designing an interdisciplinary scientific poster. Initially, we reviewed the sequential steps undertaken during Module 2 by addressing questions such as: Why are we creating this poster? What progress have we made so far? What knowledge have we gained about this or that scientific phenomenon? What core message do we wish to communicate? Following this reflection, I explained the poster construction process in detail, utilizing a step-by-step approach based on an online tutorial titled *"How to Create a Research Poster."*

During these sessions, students assumed the roles of writers or section editors, while I served as the chief editor, providing guidance and feedback throughout the process. Feedback from participants suggested that this module significantly enhanced their French language skills. Specifically, creating a poster necessitated multiple negotiations, from initial conceptualization to the finalized product, aligning with the notion of language negotiation as described by Filliettaz (2005). The key stages included:

a. Defining the core message to be conveyed
b. Developing a coherent narrative or scenario
c. Dividing the poster into textual and graphical components
d. Selecting appropriate visual materials and composing clear, concise texts often requiring the reformulation of existing texts
e. Designing engaging and informative titles
f. Monitoring the progress of the work
g. Finalizing the poster to ensure clarity, visual appeal, and coherence of the overall presentation

Throughout this process, I maintained engagement by monitoring the groups both during in-class activities and through the wiki platform, which allow me to provide comments, encouragement, advice, and motivation. The completed posters were printed in A0 format and initially exhibited in the classroom. Students engaged in a peer-review process using a predefined assessment grid, thereby fostering mutual learning and critical thinking**.** Subsequently, the posters were displayed in the hall of the Centre for Languages, Cultures, and Communication (CLCC) (see Figure 4.1).

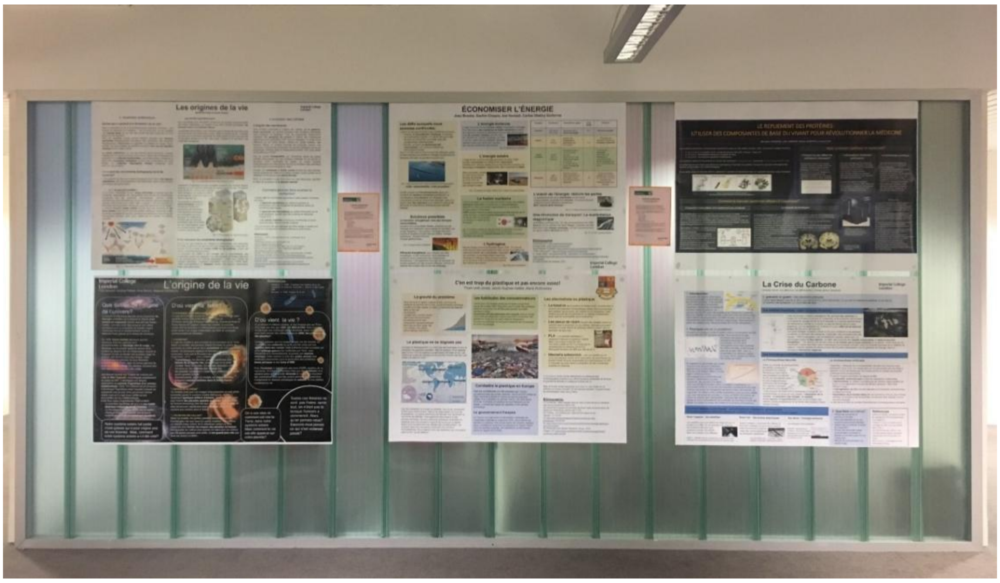

Figure 4.1 Posters displayed in the hall of the Centre for Languages, Cultures, and Communication at Imperial College London

5. Module 4: Delivering a French Presentation to Make a Scientific Phenomenon Accessible to a General Audience

The fourth module involved students preparing and delivering a 10 to 15-minute presentation aimed at popularizing the scientific phenomenon under investigation, with speaking time fairly distributed among group members. These presentations were not intended to serve as mere recitations of their posters but rather as persuasive speeches designed to emphasize the importance of supporting scientific research through actionable engagement. To achieve this, I advised students to structure their speeches following the five classical rhetorical stages—*exordium, narratio, confirmatio, refutatio, and peroratio*—originally developed to persuade audiences (Reboul, 2018).

In preparation, students analyzed extracts from two TEDx talks. The first was delivered by neuroscientist Stanislas Dehaene, titled "*Le Code de la Conscience*" (The Code of Consciousness), and the second by physicist and philosopher of science Étienne Klein, titled "*Et si faire le vide, c'était aussi faire le plein ?*" (What if emptying one's mind actually meant filling it up? —my translation). We focused on the opening minutes of these talks, paying particular attention to the rhetorical device known as the *exordium.* The *exordium* plays a crucial role in the effectiveness of a speech, as it must consider the audience's potential lack of expertise and—importantly—aim to establish a connection with them. For instance, Étienne Klein begins his discussion on the concept of the void in physics by posing the trivial question: "Vous savez tous ce que veut dire faire le plein ?" ("You all know what it means to fill up, don't you? "), thereby engaging the audience's curiosity

> " Vous savez tous ce que veut dire faire le plein ? Il faut dire que c'est facile, il suffit d'aller à la pompe à la condition évidemment que la pompe où l'on va ne soit pas une pompe à vide. Mais faire le plein, plutôt faire le vide, qu'est-ce que ça veut dire, est-ce que c'est le contraire de faire le plein ? C'est-à-dire rouler jusqu'à ce que la jauge du réservoir indique que le réservoir est vide ? "[6]

By doing so, Étienne Klein effectively captures the audience's attention, stimulates their interest, and creates a conducive atmosphere for the reception of his message. Similarly, Stanislas Dehaene employs a different approach by appealing to the audience's imagination to engage them in his discussion on neuroscience:

> " Imaginez, vous vous promenez dans la campagne, par une belle soirée d'hiver, tous vos sens sont aiguisés par le froid, et vous vous émerveillez de petites perceptions : le scintillement de la glace dans les arbres, la neige qui crisse sous vos pieds et vous vous demandez : est-ce que c'est possible que chacune de ces perceptions soit le résultat des calculs des neurones de mon cerveau, est-ce que je peux croire à cette théorie ? "[7]

This opening not only draws the audience into a vivid mental image but also provokes curiosity and reflection, thus establishing a receptive mood for the subsequent content.

We then discussed the importance of delivering speeches by balancing the three pillars of rhetoric: *logos*, *pathos,* and *ethos*. This involves not solely relying on logical argumentation but also creating space for emotional appeal and value-driven persuasion, which can effectively influence and win the audience's support.

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[6] "You all know what it means to fill up, don't you? It's easy; you just have to go to the pump, provided, of course, that the pump you use is not a vacuum pump. But, is running out the opposite of filling up? Do we create a vacuum by driving until the gauge shows that the tank is empty?" (my translation)

[7] "Imagine you are walking in the countryside on a beautiful winter evening; all your senses are heightened by the cold, and you marvel at these small perceptions: the sparkle of ice in the trees, the snow crunching under your feet, and you wonder: is it possible that each of these perceptions is the result of the calculations of the neurons in my brain? Can I believe this theory?"

Finally, we examined the optimal way to conclude a speech by analyzing the *peroration*—the concluding section—of Klein's and Dehaene's speeches. The peroration serves as the culminating moment for synthesizing key arguments and appealing to the audience's emotions through *pathos*, with the aim of encouraging them to personally take ownership of the subject matter and consider actionable steps. As Étienne Klein advises in his closing remarks:

> " et donc mon conseil est le suivant : la prochaine fois que vous aurez un coup de pompe, ou que vous vous sentirez plein de trop plein, allez faire un tour par la pensée dans cette source d'élan vital qu'est le vide quantique, et vous verrez que passer par ce vide là c'est tout le contraire d'un passage à vide. "[8]

Thus, each student group crafted a speech following these rhetorical principles, aiming to persuade their audience of the significance of their research topic and to motivate them to take action. To illustrate the rhetorical strategies employed by the groups to raise awareness about their respective projects, I will present a portion of each speech, encompassing the five rhetorical stages—*exordium, narratio, confirmatio, refutatio, and peroratio*—as extracted from recorded videos of their presentations and transcribed.

Exordium (Introduction) – presented by Tom, working with Marina and Jacob on plastic pollution:[9]:

> "imaginez un peu : vous êtes un polype coralien dans la Grande Barrière de coraille, pour ceux qui ne le savent pas, la Grande Barrière de corail, c'est en Australie et c'est la barrière de coraille la plus polluée de plastiques. Et au-dessus de vous, l'eau est complètement polluée de plastique, vous n'arrivez plus à pratiquer la photosynthèse, parce que les rayons de soleils ne vous atteignent pas, et avec chaque jour qui passe, il fait de plus en plus noir car il y a toujours plus de plastiques. Trop difficile pour vous identifier ? peut-être vous n'êtes pas des polypes coraliens, alors [...]. Passons donc à l'humanité, vous êtes pécheur en Indonésie, le pays le plus truffé de plastique du

[8] "And so, my advice is the following: the next time you feel empty, or fed up to the back teeth, take a mental journey to this source of vital momentum that is quantum vacuum, to experience that this void is the complete opposite of a dead end."

[9] "Imagine a little: you are a coral polyp in the Great Barrier Reef— for those who don't know, the Great Barrier Reef is in Australia and is the most plastic-polluted coral reef. Above you, the water is completely contaminated with plastic, and you can no longer perform photosynthesis because the sunlight cannot reach you. Each day, it gets darker because of the increasing plastic. Is it too difficult to identify with this? Perhaps you are not a coral polyp, so... let's move on to humanity. You are a fisherman in Indonesia— the country with the most plastic pollution after China. Fish are becoming fewer, and plastic is replacing them. What will you sell? How will you feed your family?" (translated by ChatGPT4o)

monde derrière la chine, les poissons sont de moins en moins nombreux et le plastique prend leur place. Qu'est-ce que vous allez vendre? comment allez-vous faire pour fournir de quoi nourrir votre famille ? "

Narration (Storytelling) – provided by Marvin, working with Harry, Micha, and Lutfir on protein folding modeling:

> " En 1859 une jeune femme se présente chez le jeune docteur Huntington, elle souffre de tremblements incontrôlables et elle a une démence faible. Le docteur essaie tous les diagnostiques qu'il a, essaie tous les traitements qu'il a, et rien n'y fait. Les tremblements s'aggravent, la démence progresse et des troubles physiologiques s'ajoutent. Après 10 ans, la patiente est mort. Il a fait ... sur cette maladie et la maladie sera appelée après lui, la maladie de Hungtington. "[10]

Confirmation (Supporting Evidence) – presented by Joey, working with Joe, Sachin, and Carlos on sustainable energies:

> " la fusion nucléaire peut être considérée comme une forme d'énergie attirante, si on tient en compte du fait qu'on produit une immense quantité d'énergie avec un tout petit peu de carburant, ce carburant consiste du deutérium et du tritium qui sont des isotopes d'hydrogène, donc on ne requiert que de l'eau, et en gros on a deux noyaux atomiques qui se fusionnent [il écrit une formule chimique au tableau] et ils deviennent l'hélium tout en libérant de l'énergie. Ainsi on approvisionnera le monde en énergie propre et abondante. ITER a pour mission d'obtenir 500 mégawatts pendant 1000 secondes avec seulement 0,5 gramme de carburant. Ceci est suffisant pour 500 000 foyers, ce qui est époustouflant, ne pensez-vous pas ? Bien que le tritium soit lui -même radioactif, les déchets ne sont pas nocifs, ce n'est que de l'hélium donc la fusion est un cran au-dessus de la fission ". [11]

[10] "In 1859, a young woman presented herself to Dr. Huntington, suffering from uncontrollable tremors and mild dementia. The doctor performed all available diagnoses and treatments, but nothing worked. The tremors worsened, the dementia progressed, and additional physiological disorders appeared. After ten years, the patient died. He conducted research on this disease, which was subsequently named after him—the Huntington's disease." (translated by ChatGPT4o)

[11] "Nuclear fusion can be considered an attractive energy source, especially considering that it produces an immense amount of energy from a very small amount of fuel. This fuel consists of deuterium and tritium, isotopes of hydrogen, which are obtained from water. Essentially, two atomic nuclei fuse (he writes a chemical formula on the board), forming helium while releasing energy. This process could provide the world with clean, abundant energy. The ITER project aims to generate 500 megawatts for 1,000 seconds using just 0.5 grams of fuel. That's enough to power 500,000 households astonishing, isn't it? Although tritium is radioactive, the waste is harmless—merely helium. Therefore, fusion is a step above fission." (translated by ChatGPT4o)

Refutation (Counterargument) – presented by Irina, working with Fran, Anishaa, and Barbara on the origin of life:

> "Galilée dit que le langage de la science est représenté par les mathématiques, donc les scientifiques écrivent des équations pour décrire l'univers, mais beaucoup de gens ne pas comprend, dans la XXe siècle, on a découvert que l'univers a eu une histoire et continue d'avoir lieu, selon l'hypothèse de Max Tegmark, la physique fondamentale contemporain est devenue de plus en plus mathématisée, nous comprenons la nature parce que nous pouvons la décrire avec des équations, il y a une réalité physique indépendante de l'homme. Chaque fois quand on parle d'une réalité objective, nous l'apercevons dans un sens essentiel, comment nous l'observons. Par exemple, le bleu n'est pas une longueur d'onde de lumière correspondant à une fréquence, c'est notre perception d'une telle lumière. La fréquence de cette lumière n'est pas une propriété, mais la façon dont nous la comprenons [12]"

Peroration (Conclusion) – delivered by Victoria, working with Heedong and Sofia on reducing carbon emissions:

> " Nous ne réalisons pas que toutes nos actions s'additionnent. Je voudrais que vous leviez la main si vous l'avez fait récemment :
>
> - Eteindre vos appareils électriques lorsque vous ne les utilisez pas
> - Utiliser des tasses recyclables
> - Essayer d'acheter des aliments locaux
> - Sécher vos vêtements à l'air au lieu de les passer au sèche-linge
>
> Comme vous pouvez le voir, ce sont toutes des petites choses que nous pouvons changer dans notre vie quotidien mais qui auront un impact très importante. Je souhaite que vous calculiez votre empreinte carbone en ligne après cette présentation et que vous réfléchissiez la façon dont vous pouvez la baisser. Le niveau de CO_2 n'a

[12] "Galileo stated that the language of science is mathematics; thus, scientists write equations to describe the universe. However, many people do not understand these equations. In the 20th century, it was discovered that the universe has a history and continues to evolve. According to Max Tegmark's hypothesis, contemporary fundamental physics has become increasingly mathematized: we understand nature because we can describe it with equations. There exists a physical reality independent of humans. Whenever we speak of an objective reality, we perceive it from a certain essential perspective—namely, how we observe it. For example, the color blue is not simply a specific wavelength of light corresponding to a particular frequency; rather, it is our perception of that light. The frequency of this light is not an inherent property but is related to our understanding of it." (translation made by ChatGPT4o)

> pas été aussi élevé depuis 3 à 5 millions d'année, si nous n'agissons pas immédiatement, notre planète sera détruite".[13]

All presentations were followed by questions from the audience.

6. Conclusion

In conclusion, this French for Science program is grounded on the conception of the student as an autonomous and responsible individual, equipped with a diverse set of language skills, academic knowledge, and life experiences. It fosters a supportive environment that sustains motivation and enhances proficiency in scientific French, while also promoting familiarity with research conducted by prominent French-speaking scientists, primarily in the French language. While English currently dominates scientific publications, the issue of utilizing languages other than English in the construction of scientific knowledge remains a matter of significance and should not be dismissed as trivial. Producing research in a single language may, in some respects, result in cognitive bias and hinder the capacity to perceive phenomena through alternative ontologies or ways of being:

> "We cut nature up, organize it into concepts, and ascribe significances in large part because we are parties to an agreement to organize it in this way—an agreement that holds throughout our speech community and is codified in the patterns of our language… all observers are not led by the same physical evidence to the same picture of the universe unless their linguistic backgrounds are similar or can somehow be calibrated (Whorf, B.L.1956: 212–4) " (North & Piccardo, 2016: 15).

One of the key strengths of this pedagogical approach is its capacity to enable language teachers to contribute to scientific fields beyond their own disciplinary expertise. The teacher's role primarily shifts to that of a mediator and facilitator, employing pedagogical mediation strategies to

[13] "We often fail to realize that all our actions add up. I would like to invite you to raise your hand if you have recently done any of the following:

- Turned off electrical devices when not in use
- Used reusable cups
- Tried to buy local food
- Dried your clothes in the air instead of using a dryer

As you can see, these are all small actions we can incorporate into our daily lives, but collectively they can have a significant impact. I encourage you to calculate your carbon footprint online after this presentation and reflect on how you might reduce it. Currently, CO_2 levels have not been this high in the last 3 to 5 million years. If we do not act immediately, our planet's future is at risk." (translation made by ChatGPT4o) sustain student motivation and gradually guide them toward greater autonomy. Such mediation involves

> "access to knowledge, encouraging others to develop their thinking (cognitive mediation: scaffolded), collaboratively co-constructing meaning within a group in a school, seminar, or workshop setting (cognitive mediation: collaborative), and creating the conditions for this through organizing and controlling space for creativity (relational mediation)" (North & Piccardo, 2016: 11).

While the language teacher initiates group activities through carefully designed instructions, students actively lead discussions and determine the direction of each session. This interdisciplinary approach values learners by placing them at the center of the educational process, leveraging their existing linguistic and scientific knowledge. The diverse roles assumed by learners across various modules, coupled with the extensive work of dual mediation throughout the program, facilitated the memorization, conceptualization, and internalization of scientific terminology in French. Over time, students become increasingly aware of their own potential, the complexity of phenomena, and the importance of engaging with real-world issues and participating in open science (Martinez Lopez, 2009).

Finally, by training students in research methodology, they learn to be critical and reflexive regarding sources and technologies used. On this point, the deployment of AI, which can intervene at every stage of the research process, must be critically examined, as "new communication means are transforming the very nature of knowledge processes"[14] (Goody, 1979: 60). While the integration of AI could potentially benefit such a program—particularly in the second module, for extracting relevant information from texts, identifying keywords, generating automatic summaries of consulted videos and articles, or providing explanations of complex terminology—it is crucial to recognize that its use is not without challenges. While its capabilities offer considerable time savings, they also raise numerous concerns: the increasing opacity of the sources it mobilizes and the risk that time savings may come at the expense of valuable insights into the construction of knowledge. For example, summaries generated by AI, rather than by the students themselves, do not allow them to understand the author's reasoning and how data were processed to arrive at the final conclusions.

[14] En français dans le texte : « les nouveaux moyens de communication transforment la nature même des processus de connaissance »

Therefore, the acquisition of languages and the training of students in research methodology remain essential for building a responsible and enlightened science— especially in an era when there is a growing belief that algorithms can comprehend the complexity of the world and provide suitable solutions to global challenges.

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