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# Teachers' perspective on the use of artificial intelligence on remote experimentation

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Remote Laboratories have become crucial educational resources due to their implementation in institutions that have adopted hybrid teaching models. Moreover, artificial intelligence (AI) has increasingly been used to develop educational support tools. Remote Laboratories suffer from a limitation: when students conduct experimental activities, instructors cannot always be immediately available to resolve doubts. To address this limitation, a virtual assistant was integrated into the Acid–Base Titration II Remote Laboratory. The aim of this research is to understand the perspective of chemistry teachers from the Common Basic Cycle of the University of Buenos Aires on the use of this artificial intelligence tool. For this purpose, a focus group was conducted in which a series of questions were asked before and after using the AI tool. The findings reveal that teachers perceive great potential in the combination of these technologies. Furthermore, the virtual assistant could offer personalised assistance in real time, which ensures accompaniment during the completion of the Remote Laboratory.

KEYWORDS

**artificial intelligence, remote experimentation, acid–base titration, chemical education, virtual assistant**

## 1 Introduction

The COVID-19 pandemic accelerated technological changes that impacted virtually every aspect of life in society. Education was no exception. In terms of natural science education, new spaces for experimentation were developed on the Web, such as ultra-concurrent remote laboratories. Furthermore, in early post-pandemic 2022, Open AI released a Generative Artificial Intelligence tool that mobilised the educational community and enabled the development of new strategies for teaching and learning (DeVon, 2024).

### 1.1 Remote laboratories

Remote educational laboratories have traditionally enabled students to access real equipment through the Internet in real time (Orduña et al., 2016), without restriction of time or geographical location. However, their use has diversified to different fields, including teaching robotics, physics, chemistry, and biology.

Over time, different types of educational remote laboratories were developed. Beyond real-time remote laboratories, ultra-concurrent remote laboratories provide access to a remote lab experience that, though fully based on real videos and data, is digitised. The combinations of what the student can do in the remote lab have been pre-recorded, and students interact with that set of pre-recorded real experiences. Ultra-concurrent laboratories are more suitable to empower laboratory activities in which students follow a set of predefined steps or paths, and in which they do make choices, but the number of potential paths is constrained. In these laboratory activities, the number of input combinations by students is limited. For example, in a particular Chemistry lesson, realistically there might be a few hundred or a few thousand combinations of what students can do in the laboratory. Therefore, it is possible to pre-record those combinations and offer an interactive experience for students to navigate through the pre-recorded experiences. This is opposed to these remote laboratories, in which the different potential actions or paths are infinite, such as those that involve programming. If students can write code and upload it to, for example, an Arduino microcontroller (Figure 1A), it is simply impossible to pre-record all the potential programs students may write. Additionally, ultra-concurrent laboratories have other benefits, such as enabling remote laboratories in fields where there is an irreversible change in the setup, for example, chemical processes (Figure 1B).

Different approaches must be taken to support the large-scale use of remote laboratories. In the case of ultra-concurrent laboratories, once the system is uploaded to the cloud, it can scale like a regular web application and support a large number of students. Each of them can experiment concurrently, seeing and interacting with the pre-recorded experience. In the case of real-time remote laboratories, multiple exact copies of the remote laboratory, ideally in different locations, need to be deployed to overcome potential local issues such as power or network outages.

## 1.2 Use of remote laboratories in science education

Experimental work is a particularly valuable component of science education. It is regarded as the optimal strategy to foster the development of desirable competencies in science education, including those related to variable measurement, procedure design, and data analysis and interpretation. However, in many educational institutions, there is a lack of laboratory spaces and equipment where students can conduct hands-on experiences, making RL a valuable educational resource for conducting experimental activities. Furthermore, the traditional approach to sustaining experimental work (hands-on), with restricted timeframes and strict protocols, does not provide sufficient freedom for students to explore the activities and self-regulate their learning.

The integration of RLs into the educational sector is not a recent phenomenon. However, its usage increased during the pandemic due to the necessity to maintain experimental activities despite the implementation of isolation measures (Idoyaga et al., 2021; Capuya et al., 2023). In the post-pandemic period, there has been a sustained growth in its use, due to the establishment of new teaching models which employ a variety of resources to develop experimental activities, such as the Extended Laboratory Model (Idoyaga, 2022), which combines the use of simple experimental activities, virtual laboratories, simulations, and remote laboratories to carry out experimentation in educational practises.

The capacity of Real-Time Laboratories to support a large number of simultaneous users is limited. Consequently, universities around the world have begun to develop and use ultra-concurrent laboratories in areas where few such developments existed. In 2020, the Universidad Estatal a Distancia developed its first remote ultra-concurrent chemistry laboratory: Acid–Base Titration I (Arguedas-Matarrita et al., 2022). The research group at the University of Buenos Aires employed this laboratory to conduct a study to describe and characterise the knowledge of teachers of the Common Basic Cycle chemistry course on teaching of acid–base titration with RL during the pandemic (Idoyaga et al., 2021).

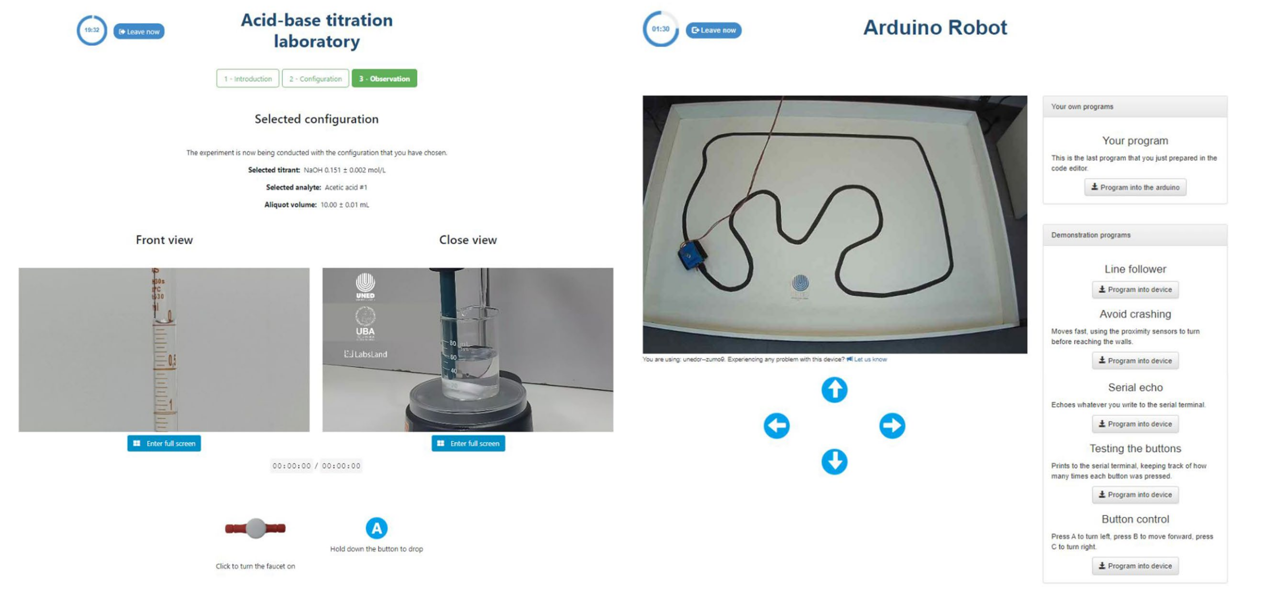


FIGURE 1
Types of educational remote laboratories, **(A)** ultra-concurrent laboratory, **(B)** real-time laboratory.

This study was conducted on a series of questions posed to teachers, and it was found that the UL is a valuable resource for the didactics of chemistry. It allows the redefinition of experimental activities and serves as a powerful resource for experimental practise, with teachers playing a key role in this process (Idoyaga et al., 2021).

In 2024, the research group of the Universidad Estatal a Distancia, in collaboration with the research group of the Universidad de Buenos Aires, conducted a study utilising this ultra-concurrent laboratory, which was implemented in the Physics and Introduction to Biophysics course of the Common Basic Cycle of the University of Buenos Aires. The findings revealed that the RLs are a valuable educational resource, particularly for hybrid or distance education proposals. Additionally, students were observed to repeat the experimental activities, which allowed them to self-regulate their learning and foster autonomy (Arias-Navarro et al., 2024).

The studies conducted (Idoyaga et al., 2021; Arias-Navarro et al., 2024) yielded a set of criteria derived from the perspectives of both teaching staff and students, suggesting potential improvements to the laboratories. In response, different versions of the ultra-concurrent laboratory Acid–Base Titration (Idoyaga et al., 2024) have been developed with the aim of adapting them to the diverse educational needs of different teaching and learning contexts.

## 1.3 Artificial intelligence and remote laboratories

The use of artificial intelligence in education has increased in recent years (Dogan et al., 2023). Artificial intelligence algorithms and educational robots support a wide range of teaching and learning activities (Costa et al., 2017). In addition, a large number of AI applications in education have emerged, such as Khanmigo, GPT-4, Duolingo, which use advanced AI systems to facilitate tasks such as personalisation of learning, continuous assessment, and immediate feedback, and support students according to their needs to enhance the learning experience (Wang et al., 2024).

Many of these resources facilitate real-time feedback and enable the personalisation of learning in accordance with the individual needs of learners. This generates a wealth of data that can be analysed in order to determine the main weaknesses of learners, thereby enabling the focus of teaching to be based on these findings (Karademir and Alper, 2024).

In the case of teachers, AI saves time in repetitive daily activities (Mindigulova et al., 2023). This resource has been used for different tasks, including automated grading systems for the correction of exams or other types of assessment, the use of virtual assistants for the resolution of doubts or the guidance of processes, adaptive learning platforms that allow content to be personalised according to students' needs, as well as other applications (Moreno, 2019). Additionally, AI enables the evaluation of teacher performance and competence, thus facilitating the enhancement of their pedagogical practise (Karademir and Alper, 2024).

Furthermore, remote laboratories have had a significant impact on education due to their flexibility and capacity to promote equity, as they facilitate access for students of diverse origins and abilities (Hussein et al., 2024). Following the pandemic, numerous institutions have implemented a teaching model that continues integrating the use of remote laboratories (García et al., 2022), which has led to an increase in the development of new laboratories and the integration of new technologies to enhance the learning experience.

One of the advances in remote experimentation is the adaptation of a personalised AI coding assistant, which allows the user to expedite the coding process (Hussein et al., 2024). A study conducted by the research group at the University of Washington investigated the adaptation of a personalised AI assistant tool, utilising OpenAI's GPT-3.5 and GPT-4 models. The tool was integrated into a remote programming lab, which was employed by digital design students at the same university. The study demonstrated the impact of AI on the students' learning experience.

Research on remote laboratories assisted by artificial intelligence is scarce, which opens up a new field of research to improve teaching-learning processes with the combination of both resources.

## 1.4 Ultra-concurrent laboratory Acid–Base Titration II integrated with IA

The ultra-concurrent laboratory of Acid–Base Titration II consists of two versions: the colorimetric and the potentiometric version (Figure 2). In the first version, users can observe the neutralisation reaction between an acid and a base through a change in solution colour. In the second version, users can observe the neutralisation reaction through a change in solution colour and pH.

Once users have selected the version they are working with, they proceed to the "Introduction" section (Figure 3A), which contains an introductory video of the laboratory setting. This provides a brief overview of the activity and the materials used to perform it. Subsequently, the "Configuration" section is displayed (Figure 3B), where users can select a titrant of known concentration and an analyte of unknown concentration. Upon selection, the final section "Observation" (Figure 3C), is displayed, where users execute the experiment. The display shows a screen with the burette containing the titrant and another with the beaker containing the analyte, the magnetic stirring tablet, and the lower part of the burette through which the titrant is dispensed, emulating what would be seen in the traditional way. This section has a stopcock that adds the titrant continuously and also has a button that allows the titrant to be added in a controlled manner, drop by drop.

In the case of the potentiometric version, in addition to the above, an interface showing the pH of the solution as the titrant is added to the analyte, is displayed in the "Observation" section.

This laboratory has been used for the past 2 years by a significant number of students enrolled in the chemistry courses offered by the Common Basic Cycle at the University of Buenos Aires. In view of the growing use of AI in recent years, a virtual assistant has been introduced in this laboratory (Figure 4). This can be observed during the three sections of "Introduction," "Configuration" and "Observation" in order to provide support to the student so that they can resolve any doubts that arise during the course of the experimental activity and receive immediate feedback, addressing the issue that the teacher cannot always be available to clarify doubts at the same time that the students carry out the experience.

The assistant uses OpenAI APIs and OpenAI models internally. At the time of writing, its default version, and the version with which it has been most extensively used, uses GPT-4o internally. The LabsLand assistant and integration are, however, designed to be highly personalisable and effectively adapted to the particular lab, the activity students are required to perform, and the teacher's preferences. Among the various personalisation features supported are, for example, the provision of supplementary context information at both the lab and

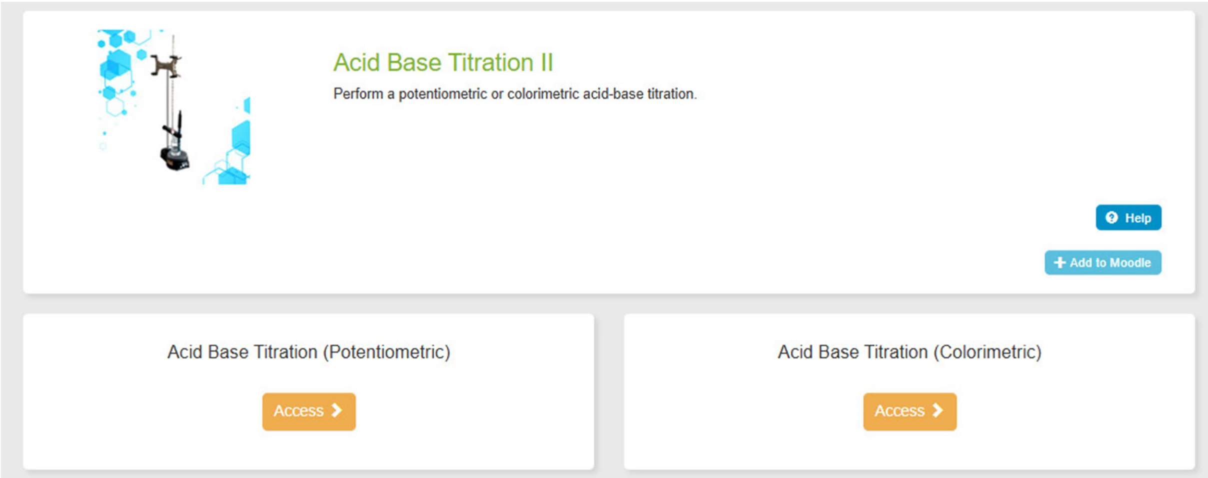


FIGURE 2
Interface of the Acid–Base Titration II Remote Laboratory.

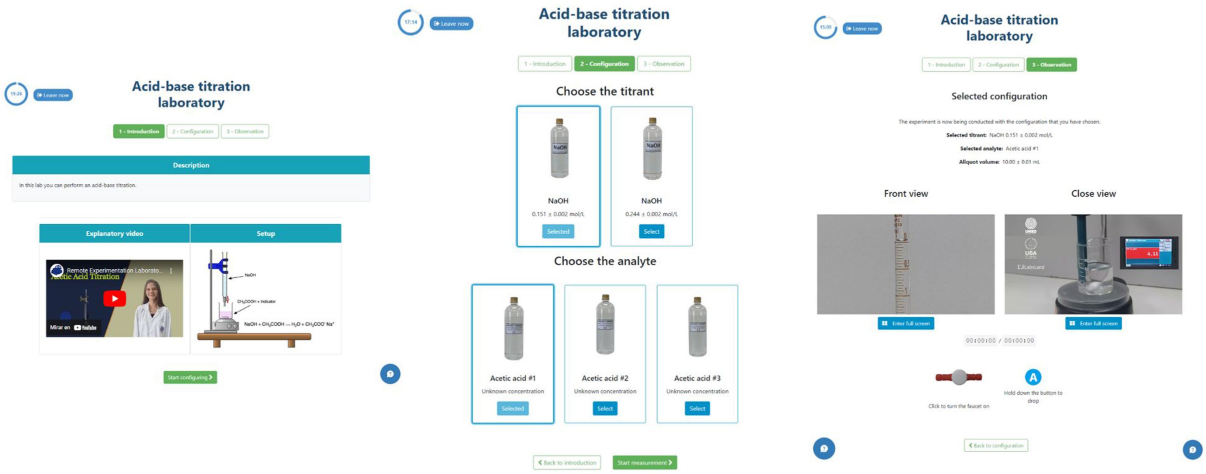


FIGURE 3
Sections of the interface of the ultra-concurrent laboratory of Acid Base Titration II. **(A)** Introduction. **(B)** Configuration. **(C)** Observation.

teacher level, as well as the context and instructions for the activity. Another feature supported is the ability to personalise certain messages, such as the welcome message, so that specific instructions or advice can be provided to students. Also relevant is the ability to specify directives to limit directives to limit the assistant's responses to the user, mostly preventing it, for example, from directly providing solutions.

The aim of this study is to understand teachers' perspectives on the use of artificial intelligence integrated into a remote laboratory and to assess its potential as a tool to support science education.

# 2 Materials and methods

## 2.1 Methods of data collection

The study was conducted by means of a focus group with five teachers of the Idoyaga Chair of Chemistry of the Common Basic Cycle of the University of Buenos Aires. The participants were selected through random cluster sampling, choosing one teacher for each time slot of the course to ensure representativeness in terms of the diversity of timetables and teaching modalities. The group was composed of teachers with different levels of experience and training (Table 1), which allowed us to obtain a wide range of perspectives on the use of technologies in chemistry teaching.

The focus group methodology was selected for its capacity to generate dynamic and in-depth interactions among participants, thereby facilitating the exchange of opinions and perceptions on a complex topic such as artificial intelligence (AI) in education. Group discussions are particularly effective when exploring emerging areas in education, such as the use of remote laboratories with virtual assistants, as they facilitate collective reflection and the collaborative construction of knowledge (Morgan, 1997; Krueger and Casey, 2015).

The focus group was conducted via videoconferencing and lasted 90 min. The session was moderated by a member of the

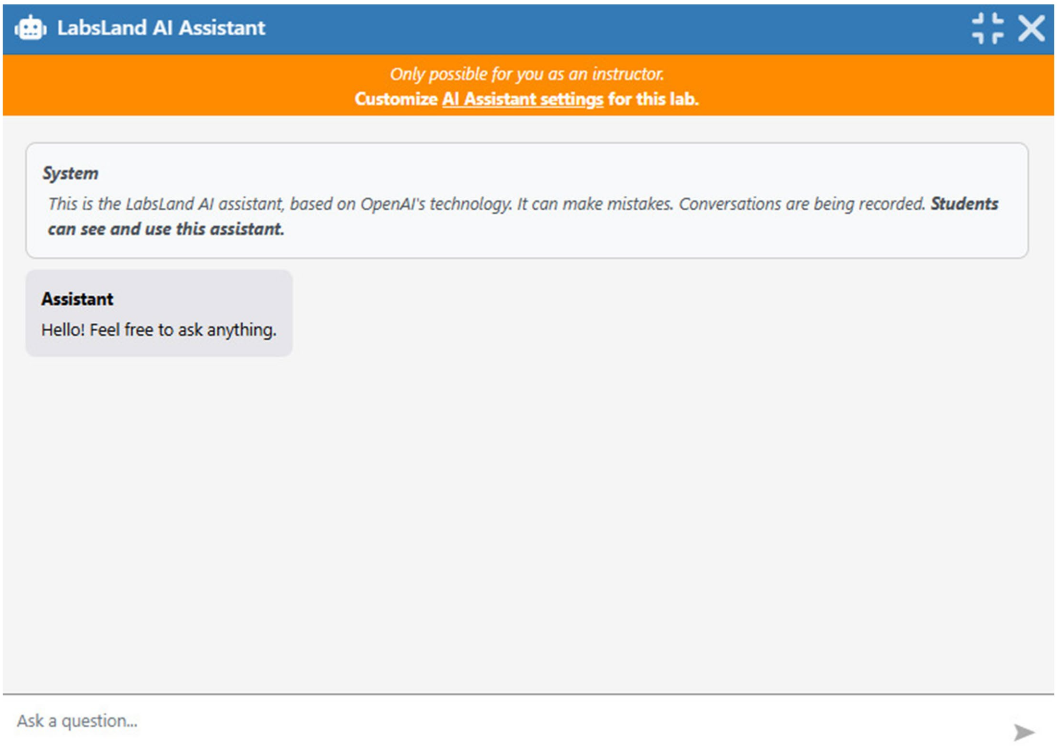


FIGURE 4
Virtual Assistant integrated into the ultra-concurrent laboratory of Acid Base Titration II.

TABLE 1 Characteristics of participating teachers.

| ID | Seniority of employment (years) | Teacher education | Postgraduate degree |
|---|---|---|---|
| T1 | 6 | Yes | Yes |
| T2 | 5 | No | No |
| T3 | 10 | Yes | Yes |
| T5 | 6 | No | No |
| T5 | 2 | Yes | Yes |

research team with expertise in chemistry and education. The moderator's role was to guide the discussion through the use of structured questions and to ensure that all participants had the opportunity to contribute to the conversation, as recommended by the methodology to obtain rich and meaningful data (Barbour, 2018).

## 2.2 Structure and phases of the focus group

The session was divided into two clearly differentiated phases, in order to assess both the participants' initial perceptions and the changes in their perceptions after interacting with an AI-assisted remote lab. This division responds to the need to assess teachers' pre- and post-intervention attitudes towards AI integration in education, using a comparative approach within the methodological framework (Fern, 2001).

### 2.2.1 Phase 1: initial perception of artificial intelligence in education

In this phase, teachers answered three key questions designed to identify their initial perceptions of the use of AI in chemistry education:

1 Are you familiar with the use of Artificial Intelligence? If so, what tools have you used and for what purpose?
2 What do you know and think about the use of artificial intelligence in education?
3 Do you think your students use AI as part of their university studies, do you have any certainty about this, and what do you think about their use of AI?

These questions were designed to explore both participants' level of familiarity with AI tools and their initial opinions and attitudes towards the use of these technologies in the educational context. This approach allows for capturing spontaneous impressions uninfluenced by immediate practical experience, providing a baseline of data for further analysis.

### 2.2.2 Phase 2: interaction with the remote laboratory and post-evaluation

In this phase, the teachers participated in an experimental activity using the Acid–Base Titration II Remote Laboratory. This laboratory allows the titration of an unknown sample of acetic acid using sodium hydroxide, and has a virtual assistant who provides support during the experience. The assistant responds to questions asked by users, and teachers can personalise it to include additional information or impose restrictions during its use, making it adaptable to different educational contexts. Teachers interacted for 15 min with the remote lab and the virtual assistant.

Subsequent to the experience, five additional questions were posed:

4. What did you think of the experience using the AI remote lab in the Focus Group? Was it easy to use? Did you find it interesting? Why?

5. Do you think this AI remote lab tool could be used in Common Basic Cycle chemistry courses? What do you think it could be used for? What changes could it bring about?

6. If you were to tell a colleague in the Common Basic Cycle chemistry department who is not here today about the positive aspects of the tool presented and the opportunities to improve your teaching, what would you tell him/her?

7. If you had to tell a colleague from the chemistry department of the Common Basic Cycle who is not here today about the negative aspects of the tool presented and the risks that its use could represent in teaching, what would you tell him/her?

8. Do you think it is necessary for teachers to have some previous training on the subject in order to feel comfortable integrating this assistant in their classes? Do you need it? If so, what kind of training?

These questions made it possible to assess the direct impact of the interaction with the remote lab integrated assistant on the teachers' opinions. Furthermore, an analysis of the usability and implementability of these tools in the Common Basic Cycle educational context was carried out, based on the teachers' personal experiences.

## 2.3 Data recording and analysis

The Focus Group was recorded in its entirety, and the audio was transcribed, identifying each of the participants' interventions. The data analysis was carried out by means of a thematic content analysis following the Bardin (2014) approach, using Atlas.ti 9 software, which facilitates the organisation, coding and analysis of large volumes of textual data.

The analysis focused on identifying the main themes and emerging patterns related to the familiarity, use and acceptance of AI in chemistry teaching. Thematic categories were established reflecting teachers' initial attitudes, their perceptions after interaction with the remote laboratory, and their proposals on the possible implementation of these technologies in Common Basic Cycle. This technique allows us to capture both the explicit responses and the implicit dynamics that emerge from group interactions (Guest et al., 2013).

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# 3 Results

The results are organised according to the questions discussed with the five teachers participating in the Focus Group.

Question one sought to explore the teachers' familiarity with the use of AI and the purpose for which they have used it. Responses varied; some of the teachers highlighted their experience and knowledge of AI usage. For example:

- T1: "…I used gpt chat…and I started using it to look up Excel formulas…";
- T5: "…I have used several tools, one to generate videos… another tool I have used are image generators…";

These answers focus on the tools that they have used, so they can be included in a "Use of AI tools" category. Other responses focused on how they have applied different resources offered by AI to their pedagogical practises. For instance:

- T1: "…to keep track of questions that I can ask my students…"
- T2: "…I also used it as a tool to see some topics that I find difficult to teach… to look for ways to express some topics…"
- T5: "… I have used it to solve certain problems, …, I ask it to give me indications so I can see how it solves the equation or what are the parameters or criteria it uses to define a law…"

These responses share the theme of using AI for teaching design, thus falling into the category "Use of AI in teaching tasks." Finally, some teachers discussed using AI for the creation of visual and audio-visual content, and its application for educational purposes. This can be seen in the following examples:

- T3: "…I used AI to create images from key words such as laboratory, remote laboratory, experience, …."
- T5: "I asked it to produce a voice from a text and that voice then we joined it to an image that could move its mouth, then with the whole process we obtained a virtual person that spoke or gave indications regarding particular things that we asked it at that moment… I have asked it to make a graphic representation of what it understands as energy, and I think how I could then use that image…"

These responses mention the creation of materials, forming the category "Generation of resources using AI."

Question two asked about the use of artificial intelligence in education by both teachers and students. Responses highlighted concerns about AI solving problems in an automated way, potentially reducing students' abilities for reflection. This is shown in the following excerpts:

- T1: "…it forces me to rethink too much what I am doing as opposed to what I used to do, for example, a linear gas problem, a student writes it completely and the intelligence solves it step by step with results and everything, and ok I can no longer put a problem like that because it implies that the student is not going to reflect or think…";
- T5: "…the expected learning is associated with problem solving so I think it is a good strategy for students to observe how we teachers solve a problem procedurally and then they can compare it, how we teachers think and the AI… it has made me rethink my pedagogical practises and especially with respect to the expected learning";

These reflections suggest that teachers should adjust their assessment approaches to encourage critical thinking, which can be categorised as "Rethinking teaching and assessment: Impact of AI on problem solving." Reflections on the use of AI for searching and organising academic information were also found. In particular, the following can be observed in the T5 response:

- T5: "…if I ask what the characteristics of the URM are, the gpt chat will give me a precise description… Others that I have used are academic search programs, when I have to look for information to write an article or paper, I use this AI, which is academic, which only has safeguarded searches with certain publication standards, so it helps me to filter the information that I am going to use";

The answer above focuses on how AI can help us find relevant data more efficiently, creating a new category called "Academic information filtering."

Question three sought to explore students' use of AI as part of their university studies, where different teachers' narratives of their students' experiences of using AI to solve problems and create PowerPoint presentations appeared. This is evidenced in the following discursive episodes:

- T2: "…it happened to me that some students told me 'teacher, we put that problem in chat gpt for you to solve it', they had brought it printed to show me what the chat had given them as an answer…the steps they had to do to solve the exercise were detailed, and they told me 'we do not understand it, we did not understand it that way', so we saw it in class…";
- T5 "…students say they use generative PowerPoint intelligences, they give a topic and tell the AI to make a presentation for them";

The use of AI by students to facilitate the understanding and performance of tasks constitutes the category "Use of AI for problem solving and tasks." Opinions were also expressed on the role of AI in the teaching role, emphasising that AI will not replace teachers, but will change the focus and nature of their work. This is reflected in the following responses:

- T4: "I do not think that it will replace us, but that we will have to refocus the effort…we can accompany the student by putting context, talking, communicating with them…";
- T5: "I do not think AI can replace us, from my perspective the role of the teacher goes far beyond teaching them to solve problems…";

The above responses highlight aspects that indicate that teachers will continue to encourage critical thinking and help students contextualise information, this generates the category "Use of AI as a complement to teachers work and not as a replacement."

Teachers also considered the necessity of instructing students in the critical evaluation of AI. This is exemplified in the following discursive episodes:

- T4: "…to see if what the AI is saying is true or seems to be wrong, to generate a criterion, to know where the information came from, …";
- T3: "…it would be very good for my students to tell me how they are doing it and what they are doing and then establish a dialogue in the classroom, a reflection on what data it can give you and what it can be useful for…";

The comments address the necessity of discerning the veracity of the information provided by AI and, consequently, of making informed decisions regarding the data that AI offers. These considerations form the category "Ethical and responsible use of AI."

Question 4 sought to know the teachers' perception of the experience after having used a virtual assistant integrated to the Acid–Base Titration II Remote Laboratory. Some of the responses obtained highlight the ease of use of the tool, for example:

- T1: "I liked that you could enlarge the screen… it is very intuitive to use, very simple."
- T2: "… I asked it some questions, it is quite good, …, it is quite intuitive to use it.";
- T5: "…I think it is interesting, it is easy to access…";

The responses indicate that the use of the virtual assistant is simple and intuitive, which can be categorised as "Accessibility and ease of use." Furthermore, some of the responses include aspects on the importance of the AI not only answering questions but also suggesting questions to students, for example:

- T3: "…to ask questions that address certain things that some teachers want to focus on, in this case the specific part of this remote lab;
- T5: "…I would set it up so that students not only leave questions for the AI, but the AI also asks students questions…I think students could use it more";

The aspects mentioned above highlight the importance of a more dynamic dialogue, which constitutes the category "Interaction between IA and students."

Some teachers provide opinions that suggest improving the tool, as evidenced by the following responses:

- T1: "…I would add some self-defined questions so that the student has models of questions that can be asked later…";
- T4: "…when I asked what the validation would be used for in the medical context, a lot of examples appeared but not the one

we have in the practical work, it would be good if we could incorporate it…";

The above opinions incorporate aspects on how to guide the student and personalise the laboratory according to the learning needs, which generates the category "Suggestions for improvement."

In some courses at the University of Buenos Aires, the Acid–Base Titration II Remote Laboratory has been employed. Consequently, question 5 sought to know the opinion of the teachers regarding the use of this laboratory but with the integrated AI tool. Responses highlighted how AI can help students improve the quality of reports. This is evidenced in the following discursive episodes:

- T1: "The change that could be generated would be for students to ask more directed questions…it would be a good addition because afterwards it would generate more productive questions that are not so general…also incorporate the fundamentals of how to put together the report…";
- T5: "…I think it could greatly improve the quality of the reports…";

Relevant points are highlighted on how students will be able to make more focused questions on the topics studied and how AI could help in the preparation of reports, which forms the category "Improving the quality of questions and reports." Additionally, comments pertaining to the potential of AI to facilitate student learning in practical procedures and data analysis are collated and presented below:

- T1: "…it would help to solve quick questions, for example, how do I set it up, how do I take the data…";
- T5: "…Students could directly ask the assistant what are the procedures they should follow… how could they analyze the data…";

These responses gather opinions on how AI can facilitate the understanding of experimental activities, which is included in the category "Support for data analysis."

There are also comments on how the use of AI could lead teachers to rethink the way they evaluate reports and their results, in addition to considering new ways of presenting content, as evidenced in discursive episodes such as:

- T3: "…I would rethink how we present this, I would do a class discussion of results and analyze what is going on…";
- T5: "…I would have to rethink the way in which we are going to evaluate this report…";

The comments highlight the need to change the traditional approach of assessment, which constitutes the category "Rethinking assessment and teaching."

Questions 6 and 7 sought to inquire about opportunities and challenges that teachers found when using the lab with the integrated AI tool. According to the responses, some teachers emphasise how AI can reduce repetitive classroom tasks, for example:

- T1: "The first thing I would say is that it's great, because it would reduce the number of times I'm going to repeat the same thing in a class…"
- T3: "…it gives us more time in the classroom, to take advantage of it, because they can do some things at home…."
- T5: "…it's great because it provides a guide for students to use at home or wherever they have Internet."

The above responses highlight that the use of this tool frees up time for more complex tasks, which generates the category "Positive aspects, increased efficiency and extra time."

In addition, some of the responses reflect the need for teachers to be better prepared, as the AI will resolve fundamental doubts, and it is also important to highlight that the teacher's discourse needs to be coherent with the answers generated by the AI, as shown in the following responses:

- T1: "Be very prepared because the questions will be much more complex than they were before… all the general questions will be solved by the chat…"
- T3: "…It is a tool that is going to demand us to know how to use it ourselves, like anything we do in the classroom, to anticipate…";
- T5: "…our discourse should be coherent with the discourse the AI poses…"

The aspects mentioned above imply that students will ask more focused questions with a greater level of depth, which constitutes the category "Opportunities to improve teaching from teacher preparation."

Finally, the risks of leaving students to use the tool on their own without adequate support are highlighted. It is also mentioned that the information given in class should be more coherent and in-depth. For example:

- T2: '…we have to accompany them, it is not just a matter of leaving them to find it…';
- T3: '…it is a challenge for us to prepare ourselves for what may come in the field of education…';
- T5: '…the challenge is to be better prepared, because maybe the superficial information that we used to give them, now they will have it directly…"

The above responses bring together aspects of the challenges that the use of the tool would present, these constitute the category "Risks and Challenges."

In response to question 8, the teachers were asked to indicate their views on the necessity for prior training (in the form of workshops or other educational activities) in order to ensure the effective use of this tool in the classroom. Some of the responses highlighted the importance of a training session to highlight the types of questions that would be most useful for students. This is exemplified by the following answers:

- T2: "It would be useful to know whether it is used before, during or after class and what kind of questions can be asked";
- T4: "It would be good if we could see which questions are most frequently asked so that we could emphasise them afterwards";

This highlights the importance of knowing how students use the tool, considering both the time of the class when they use it and the type of questions they ask, which is included in the category "Use and implementation strategies." The opinions of some teachers are also presented, who agree on the importance of having a general knowledge of AI and its types, as well as showing the limits it presents. This is evident in the following discursive episodes:

- T1: "…it is necessary to have a day to make this visible, …, it is necessary to show what the limits of the tool are so that teachers do not consider that it is all powerful…";
- T5: '…I think that we teachers need to have some basic references of the various types of AI, at least in a general sense";

The responses show the need for initial training to enable familiarisation with AI tools and their respective capabilities and limitations, which constitutes the category "Basic AI training."

A collaborative workshop between teachers is also suggested. This is evidenced in the answer to T3:

- T3: "It would be good to see the opinion of others, what types of planning or what types of strategies they were already using in their classrooms and how this can be adapted…a training workshop where more people contribute will help us all."

This highlights the importance of having a space where ideas and strategies that have been used in the classroom can be shared and thereby the tool can be adapted to different educational contexts, which generates the category "Collaboration between teachers and training workshops."

## 4 Discussion

Firstly, with respect to the teachers' perspective on different AI tools, this paper reveals a number of aspects related to the impact of these developments on educational practises, particularly in the context of the research, the chemistry courses of the Common Basic Cycle of the University of Buenos Aires. The results show that most of the participating teachers have some experience using AI tools, such as natural language models or other generative AI, to achieve specific goals related to problem solving or task automation. In this sense, it can be assumed that teachers have been testing and using these tools to perform some of their teaching tasks, which presumably would allow for a different management and organisation of time and effort. This coincides with what was reported by the study of Uygun (2024), whose main purpose was to know the perspective of teachers regarding the use of different AI tools in education. These authors report that a large number of teachers see AI as a valuable resource for accessing information and optimising teaching work.

In relation to teaching design, it was found that teachers face challenges with the massification of AI. The main challenge would lie in redefining assessment strategies. Some forms of summative assessment such as solving algorithmic exercises or very specific questions could be solved automatically. Also, some teachers point out a certain fear about the possible lack of autonomy and reflective capacity on the part of students when carrying out tasks using AI. In contrast, other teachers see it as an opportunity for students to analyse how AI tools solve problems and how the teacher solves them in class. They also point to the ease with which these tools make it easier to organise the search for information. These teachers' opinions show the need for a paradigm shift in traditional education, since AI promotes the use of new methods and technologies that provide students with different learning experiences, which could generate a change in the ways of learning (Uygun, 2024; Vercellotti, 2018; Zhufeng and Sitthiworachart, 2021).

Teachers, in general terms, that developing the ability to discern the accuracy of the information provided by AI is fundamental within the educational context as it encourages a more critical and reflective use of the tool, which allows for monitoring some of the ethical implications of AI use. As Sullivan et al. (2023) study highlights, the responses provided by AI can have an impact on the quality of education (Smith et al., 2021; Zeer et al., 2023; Sullivan et al., 2023). In this sense, teachers state that AI will not replace teaching, although the use of AI could transform traditional teaching methodologies, teachers would still need to provide support to ensure students' critical understanding.

Secondly, with reference to the AI tools integrated into RL, the study makes it clear how easy it was to use the AI tool in RL, as it is very intuitive. This suggests that the assistant can be easily integrated into various educational environments. It also focuses on the importance of an interaction between the AI and the learner, where there is a dynamic exchange that makes the experience more immersive.

The teachers highlight the potential of the tool to help students improve the quality of the reports and guide them during the development of the experimental activity, both with the procedures to be followed and with the analysis of the data. The latter highlights the importance of rethinking the evaluation, since the AI will be involved in the reporting process, and thus take advantage of the benefits of remote laboratories to repeat an experience as many times as necessary, with some form of feedback or resolution of queries.

Teachers also commented on the opportunities and challenges they observed in using the tool. Positive aspects highlighted were the ability of the assistant to provide individualised attention which would reduce the need for the teacher to intervene directly on repetitive issues, allowing the teacher to focus their attention on more complex problems.

In contrast to the above, it is highlighted that one of the risks is not giving adequate support to students with the use of the assistant, as it is necessary to make a critical use of it and avoid the misuse of AI. In addition, one of the challenges is that the questions that students ask teachers will be more focused and complex, which requires better preparation of the teacher, not only in the theoretical component but also in terms of the use of the tool.

Thirdly, with regard to training needs, the teachers believe that in order to implement this tool in their classes, it would be beneficial to have some kind of prior training. Specifically, they stress the need for in-depth knowledge of AI types and tools and the limitations they present. This point is crucial, as the teacher will be responsible for leading the inclusion of this type of technology in educational proposals. Moreover, the participating teachers themselves emphasise that in the training proposals they would not only seek to learn about these technologies, but also to have an exchange on the strategies they use in different educational contexts. This dialogue between colleagues would allow for the co-construction of new methodologies that respond to educational needs and optimise the use of technology.

In short, the study reveals a consensus among the participants that tools under investigation could be valuable in the context of teachers' and students' performance. Consequently, these new LRs with AI, which allow for configuration by teachers, could be strategies to reinforce support. This approach effectively addresses the criticisms associated with the lack of support strategies for students' autonomous work in remote experimentation (Matarrita and Concari, 2018).

## 5 Conclusion

The study shows, according to the perception of the participating teachers, the educational potential that the combination of these two technologies has, as they highlight some aspects such as improving teaching from the preparation of each teacher, as well as freeing up time in class that can be used to focus on other more important things, as AI can solve basic doubts, among others. Therefore, the interest of the study lies in the importance of investigating how these technologies impact on educational practises, particularly in the ways of teaching and learning. These developments also respond to the need to lay solid foundations for educational innovation and to consider strategies for continuous teacher training. In addition, new practises in higher education that can be transferred to other contexts, such as secondary schools, are shown, making it possible to rethink the teaching of natural sciences in a world that is becoming increasingly digitalised.

The development of this study holds the promise of providing personalised support in real time, which would allow students to have continuous support during the development of experimental activities. A key aspect to enhance learning in virtual environments where remote laboratories are used.

The categories that emerged in this research can be the starting point for a broader study involving both teachers and students using remote labs assisted with AI tools, to establish the advantages, disadvantages and opportunities for improvement of activities involving the joint use of these resources.

## 6 Future perspectives

The use of the AI tool integrated into the remote laboratory shows great potential for providing continuous support during the development of experimental activities. However, this study focused exclusively on the perceptions of the teachers who participated in the focus group. Consequently, it is hoped that further research will focus on the interaction of students with the tool, in order to gain a comprehensive understanding of its impact on learning.

The inclusion of the AI tool described in this article has a high potential for scalability to other remote laboratories, and it is expected that its scope and applicability will be expanded.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Author contributions

FL-S: Conceptualization, Formal analysis, Investigation, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. II: Conceptualization, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft. PO: Conceptualization, Investigation, Resources, Visualization, Writing – original draft. LR-G: Conceptualization, Investigation, Resources, Visualization, Writing – original draft, Writing – review & editing. CA-M: Conceptualization, Funding acquisition, Investigation, Project administration, Supervision, Validation, Visualization, Writing – original draft.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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