

# Surveying teachers' readiness to incorporate digital technologies in inquiry-based laboratories: the development of a tool and initial findings

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**Abstract.** The ADELANTE national project aims at facilitating the adoption of investigative laboratories enhanced by digital technologies in secondary school. A country-wide network of 16 “teacher leaders” was established to develop teaching-learning sequences featuring digitally enhanced laboratories, to be shared with a wider community of teachers in the next phase. To monitor teachers' competences across the program, a survey was developed. This contribution outlines the criteria and process for the construction of the survey and illustrates the results of its administration to the teacher leaders at the beginning of their professional development journey.

## Introduction and theoretical framework

Numerous international documents advocate for innovating school labs with an investigative approach. However, teachers encounter barriers such as limited understanding of inquiry-based pedagogies and lack of resources [1]. Digital technologies, such as Arduino microcontrollers and smartphones, offer affordable tools that can facilitate the development of students' agency and experimental skills. While experiments using these technologies abound, there is a lack of reflection on their integration into teaching-learning sequences (TLSs) and on the learning goals they can contribute to achieving. Another under-researched aspect is teachers' preparation for carrying out this integration. The ADELANTE (Adopting Digitally Enhanced Laboratories in a Network of Teachers) project aims to facilitate the adoption of technology-enhanced labs by leveraging teacher learning communities. In the first phase, a group of “teacher leaders” [2] will develop TLSs, which will be shared with a wider community of teachers in the second year. To shape the teachers' professional development journey, a survey has been designed aimed at gaining insights into the following research question: *To what extent are high-school teachers prepared to incorporate digital technologies into inquiry-based laboratories?*

## Methods and findings

To construct the survey, two key dimensions were identified [3]: (1) integration of digital technologies into high-school laboratories and (2) approach to laboratory activities. For the technology section, existing surveys were considered, but they did not capture the developmental nature of teachers' competence that inspired our project. Such an approach was well represented by the DigCompEdu (DCE) framework [4], which, however, pertains to technology in general rather than laboratory technologies. To adapt the DCE format to our research, it was analysed to identify different sub-dimensions of competence. Ten questions were constructed to cover these dimensions, and each question was mapped across the 6 “levels of use” considered in the DCE (Table 1 and Figure 1). The second section consists of two parts. The first assesses the alignment of teachers' practices with inquiry-based pedagogies, partially self-constructed and partially inspired by the “instructor survey” used within the E-CLASS protocol and related studies. The second part focussed on the goals of laboratory activities, inspired by both existing research [5]

and initial interviews with the teachers. The survey was administered to group of N=15 teacher leaders during the kick-off meeting of the project in January 2024. The findings reveal a diverse situation, even within a “selected” group of teachers.

Section	Dimensions [sub-dimensions when applicable]
<b>1: Technologies</b>	<b>A: Levels of use of digital technologies for instructional laboratories</b> [Q1-Q3] Technologies and pedagogies in relation to the learning goals [Q4-Q7] Students’ agency, problem solving, collaboration, and inclusion [Q8-Q10] Engagement in professional development
	<b>B: Technical knowledge and skills</b>
	<b>C: Use of technology in relation to traditional instrumentation</b>
	<b>D: Relationship between science and technology</b>
<b>2: Approach to lab activities</b>	<b>A: Orientation towards inquiry-based learning</b>
	<b>B: Activities carried out by students [6]</b>
	<b>C: Learning goals of the physics laboratory [7]</b>

Tab. 1. Structure of the survey developed for the ADELANTE project.

**4: Using technology to enhance active learning, students' agency, and decision-making in the laboratory.**



Fig. 1. A sample question from the “Technologies” section of the survey and teachers’ (N=15) answers.

## Conclusions

The results from the survey will form the basis for developing our professional development program. The survey will be extended to the larger group of teachers involved in phase 2 of the project and will be administered at different stages of the program to monitor the evolution of teachers’ competencies. Qualitative data sources, such as interviews and focus groups, will be used to add nuance to the findings. Additionally, we plan to propose the survey to the wider community of Italian high-school teachers to establish a nationwide benchmark.

## References

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