

Smart education in Romania: lessons learned from equipping high schools through the National Recovery and Resilience Plan

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Abstract

This study aims to examine the dynamics between funding institutions and beneficiaries, with a particular focus on identifying the factors that facilitated successful project implementation and those that contributed to delays or contract terminations. Furthermore, the analysis seeks to evaluate the extent to which these dynamics influence students' access to a modern and innovative educational process. In this paper there are reviewed different approaches in evaluation as result based evaluation and theory-based evaluation, arguing their relevance in the actual context of policy making. The research is based on data analysis and a survey with a representative group of beneficiaries for a better understanding of their perspective. Evidence from the cases indicates that capacity and expertise gaps on both the funder and beneficiary sides were salient drivers of implementation complications and delays; these experiences appear to have reduced beneficiaries' willingness to apply for subsequent funding opportunities. For evaluation practitioners this study is an opportunity to adapt and refine their methods in order to improve their program evaluation considering more the context and the secondary effects. The novelty of this paper lies in the fact that, until now, the dynamics between the state institutions involved and the beneficiaries, as well as the outcomes achieved, have not been analysed. The results of this analysis may serve as a foundation for a new approach to future funding initiatives.

Keywords: smart cities, digital transformation, infrastructure management, EU funds, digitalization.

1. Introduction

In recent years, educational policies have been marked by rapid transformations, accelerated not only by the global technological pace, but also by the shock of the pandemic, which forced the entire education system to digitize almost overnight. During this period, teachers and students have been forced to adopt new platforms, experiment with alternative teaching methods, and develop digital skills that, until then, were more of a desideratum than an immediate requirement. This abrupt transition has highlighted both the fragility of the existing infrastructure and the transformative potential of digital investments when they are well calibrated to real needs.

This transformation takes on increased significance in a complex socio-economic context: according to data provided by Eurostat, Romania is among the countries with the highest unemployment rates among young people aged 15 to 24 [1]. In this sense, the introduction of new technologies in schools represents not only an adaptation to the pandemic realities, but also a strategic opportunity: students can acquire digital competences and relevant skills that will increase their competitiveness on the labour market.

The integration of new technologies in teaching is closely linked to the factors that lead to school dropout among high school students. According to a report prepared by the National Centre for Educational Policies and Evaluation in Romania under the Ministry of Education and Research the main reason for school dropout (over 50% of respondents) is that they believe they are not learning anything new that will help them further in life [2].

The opportunity that Romania had with this funding and the way it was perceived, is the sum of the need of the education system and the capacity and desire of the people in the system to implement such projects. Thus, this paper explores these institutional interactions, focusing on the factors that facilitated the efficient implementation of projects, but also those that generated delays, blockages or terminations. The analysis also follows how these administrative and operational mechanisms affect students' access to a modern education, strengthened by digital skills initially developed out of necessity and later becoming an integral part of the educational process.

2. Evaluation and SMART education

A fundamental element of current educational policies is the transition to SMART education, defined as a coherent and efficient use of ICT technologies to support personalized learning processes, based on collaboration, adaptability and innovative pedagogies. This educational model emphasizes the development of advanced skills, critical thinking and the ability to navigate in dynamic contexts, thus becoming an essential benchmark for evaluating investments in school digital infrastructure. The integration of the SMART education concept in the present analysis allows the interpretation of the results not only from the perspective of material endowment, but also from the perspective of transforming teaching-learning processes [3].

Aligned with the principles of SMART education, the OBSL method provides a dynamic framework for developing interdisciplinary understanding and higher-order thinking. It nurtures critical engagement with STEM content, encourages teamwork and cross-disciplinary reasoning, and supports long-term planning skills. By emphasizing communication—listening, speaking, and writing—the method contributes to the formation of well-rounded learners capable of navigating technologically enriched environments. Its openness to trial-and-error learning further strengthens students' adaptive capacities, a cornerstone of modern educational ecosystems [4].

The innovative element of this research is given by the fact that it incorporates several key concepts in evaluation, making it easier to be used by the funders, the beneficiaries and stakeholders in designing relevant public policies. Therefore, our aim is to conduct an evaluation that assesses the projects results, the institutional capacity and the processes that lead to the results in order to extract some good practices and to shape better future programmes.

The classic programme theory describes how the intervention should be implemented in order to produce its expected effects. The difference between the realist approach and other programme theory-based evaluation models is that a realist programme theory specifies

what mechanisms will generate the outcomes and in which context. Realist evaluation, through its central analytical tool—the Context–Mechanism–Outcome (CMO) configuration, is based on the premise that programs work or not depending on how the individuals respond to program resources and incentives, and these responses generate outcomes. [5] A low implementation fidelity is a reflection of a low degree to which the intervention is delivered as intended by its designers, while a high fidelity would mean that the programme follows the prescriptive model.

Absorptive capacity assessment evaluates an organisation’s ability to recognise, assimilate and apply external resources or knowledge. [6] We study the institutional capacity as a determinant of success and also as an outcome of the implementation experience. An important indicator of the institutional capacity development is represented by the willingness to reapply to similar funding opportunities.

Evaluation literature highlights how oversight rules, reporting obligations and compliance procedures may raise administrative burdens for beneficiaries and determinate a slower implementation [7]. Our research documents the contribution of the monitoring mechanisms to programme’s outcome, if they stimulate a successful implementation or they are a risk factor that leads to delays and to failure in obtaining results.

3. Methodology

3.1. Methods and instruments

This paper used both qualitative and quantitative methods in a complementary manner to capture in depth the dynamics between funding institutions and beneficiaries and to gain a nuanced understanding of how the projects were implemented. Document analysis constituted the first methodological stage, being used both to substantiate the theoretical framework — by reviewing the specialized literature and contemporary approaches in the field of program evaluation — and to examine in detail the official information on the funding program, its objectives, the structure of interventions and the measures adopted by the authorities at different points in the implementation. This stage allowed for the outline of the institutional and operational context in which the projects were carried out, as well as the identification of the main structural challenges influencing the relationship between the funder and the beneficiary.

In order to integrate the beneficiaries’ perspective and observe how they experienced the implementation process, a structured questionnaire was developed and applied, consisting of 21 closed and three open questions. The instrument was designed to measure a series of essential dimensions of implementation, such as: the duration of the procurement procedures, the level of involvement of the financier, the role of other institutions in direct relationship with the beneficiaries the beneficiaries’ availability to access future grants, as well as the perception of the usefulness and impact of the investment. The open questions offered the possibility of collecting additional explanations, allowing the capture of nuances, justifications and concrete experiences that cannot be captured exclusively through standardized items such as working with external consulting firms from own funds. The questionnaire was open for completion over a period of 11 days, by self-completion, in online format, using the digital tool Google Forms.

3.2. Target group

The target group was made up of all 1111 beneficiaries of the program, corresponding to the number of contracts signed at national level. They were distributed in all 41 counties of Romania, plus the Municipality of Bucharest. However, the territorial distribution of funding was uneven, being influenced by the number of existing high school units in each county. This sample structure allows for a representative image at national level. The number of questionnaire respondents represents 1/3 of the total number of possible respondents.

3.3. Limits

A first limitation is the lack of access to the current status of all contracts. The funder did not make public the number of terminated contracts out of the 1111 signed or the reasons that led to the termination of the contracts.

A second limitation is the lack of access to all beneficiaries; we were not able to contact all 1111 units to send them the invitation to complete the questionnaire due to time restrictions.

The third limitation of the research is the small number of documents written on this topic in Romania regarding the access, implementation and impact of the NRNP component.

4. Information about the program

The measures proposed in the NRRP seek to ensure continuity of the reforms initiated prior to the health crisis caused by the pandemic context, while adding new commitments that align with current priorities. Component C15 – Education is part of the Pillar VI – Policies for the Next Generation, Children and Youth dedicated to reforms in the educational system through investments in infrastructure, digitalization, and equipment aligned with current and future labour market needs. Alongside infrastructure modernization, the component includes measures to prevent and reduce school dropout, to develop digital skills for teachers and students, curriculum adaptation and to involve the private sector in sustainable partnerships to stimulate dual education [8]. For the 7 reforms and 18 investments under this component has been allocated a total budget of €3,605.97 million [9].

Component C15 is linked to the Integrated National Energy and Climate Plan 2021–2030 (INECP) through its indirect contribution in two objectives: Energy efficiency and Decarbonisation – GHG emissions and removals, and energy from renewable sources. [10] All the investments under NRRP must comply to the principle Do no Significant Harm. The reforms under Component C15 are also complementary to the objectives of the EU's Digital Strategy, consolidating the digital skills of the citizens. Moreover, the efforts of modernizing the Romanian educational system are continued by the Operational Programs 2021-2027 for an optimal use of European funds [10].

Our research focuses on the NRRP Call: I9 - Equipping upper secondary education institutions with smart laboratories ("smart labs"), part of the initiatives package of Component C15. The main objective of this call is equipping state/private upper secondary

education units as well as children's palaces and clubs with "smart lab" type ICT equipment and specific educational materials for the development of an intelligent digital laboratory. The laboratories may be used in all study subjects, with the possibility of being adapted to the profile of any high school [11]. The total budget for this call was around €118 million. Every unit could apply for 1 or 2 smart labs, depending on the number of enrolled pupils in 2022-2023; in case the number was minimum 500, the unit was eligible for the second intelligent laboratory. The maximum budget for each smart lab was the equivalent in the national currency of €60.000. For this call, the applications had to be submitted on a platform designed especially for it [12]. It is significant to mention that all the equipment proposed to be financed had to comply to a set of norms that the Ministry of Education imposed. This aspect is very important because through the legislative framework it was created a standard of quality for the new smart labs.

For a better understanding, we will review the timeline of this call, highlighting the major phases. The applicant's guide has been launched for public consultation at the end of 2022, announcing the opening date of the call as December 23 and the deadline for submitting the online applications being March 15 2023. On March 14, a press release stated that the application period was extended until March 24 [13]. The list of the admitted projects was published at the end of May 2023. The total contracted budget was approximately €85 million and there were contracted 1111 projects of a total of 1120 units that had been admitted to financing. The majority of the projects are in the public sector and there are 42 private beneficiaries. A number of 310 high schools applied for two smart laboratories [11].

The first contracts were signed starting with January 2024, with a big delay from the initial proposed calendar. The initial project implementation deadline was January 31 2025, so the implementation period was reduced at one year. The deadline was later extended three times: first to the end of March, second time to December 31 2025 and the last time to March 31 2026. During this period, the reporting process was constantly updated, the beneficiaries being asked to provide the contracting authority, Executive Unit for Financing Higher Education, Research, Development and Innovation, more data compared to the initial requires.

5. Evaluation report

Following the application of the questionnaire, 369 unique responses (unique beneficiaries) were recorded, here are the results for each item. Also, as mentioned in the Methodology section, the number of responses received amounts to 1/3 of the maximum number of possible responses. At the same time, the 1/3 weight of responses was also maintained regarding the number of laboratories in a unit. Thus, 1/3 of the total number of respondents responded with a single smartlab, 1/3 of the total number of respondents with two smartlabs. Additionally, we also maintained the 1/3 weight with regard to state and private units.

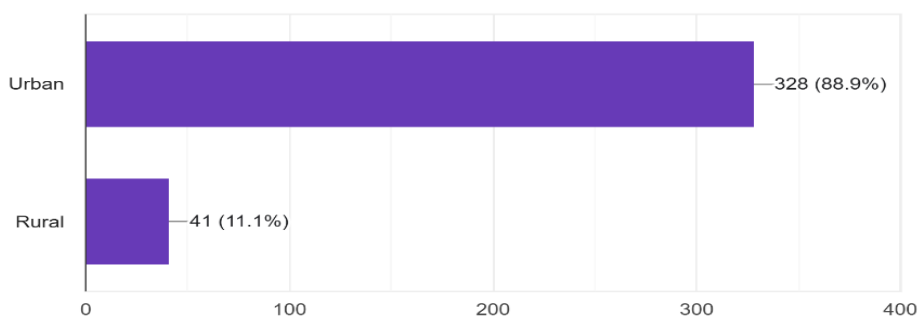


Fig. 1 Geographical distribution

The majority of the respondents are from the urban areas, confirming the decreasing in the number of high schools in the rural area, making the participation at school of pupils that live in the rural area more difficult. This result is

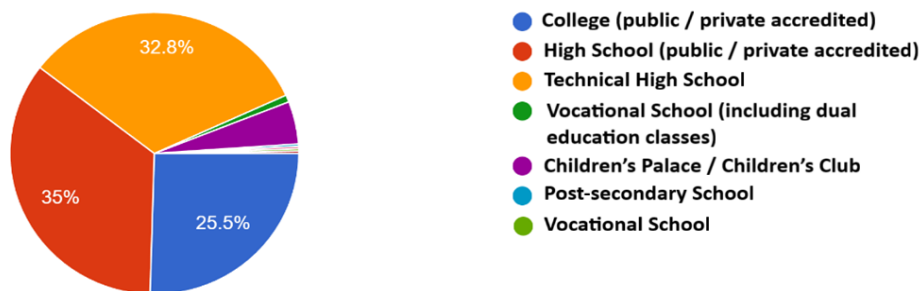


Fig. 2 Type of institution

The major categories of beneficiaries of the smart lab investments are high schools, technical high schools, followed by state colleges and children palaces or clubs.

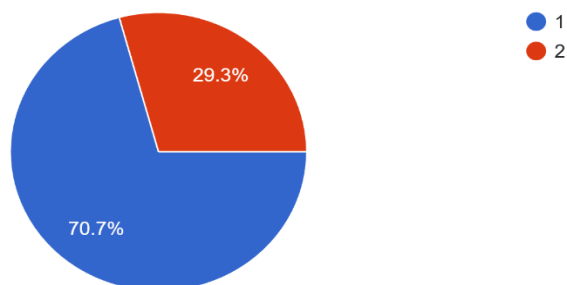


Fig. 3 Number of smartlab for each unit

As may be observed in the chart above, most of the units applied for equipping one smart lab. It is essential to mention that this distribution is insufficient for understanding how many units were eligible for equipping a second smart lab but submitted a project for only one.

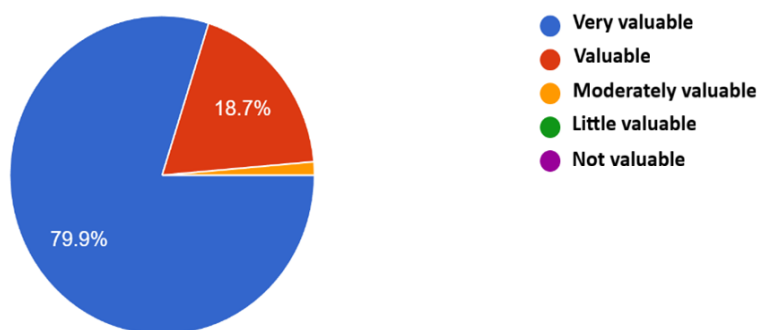


Fig. 4 The perception of opportunity

The perception about this financing opportunity is almost unanimously considered valuable and very valuable for the Romanian educational system in order to modernize the infrastructure, develop digital competences and even equip existing laboratories. Moreover, many respondents underlined the fact that it was a rare opportunity and it was an important motivation for application.

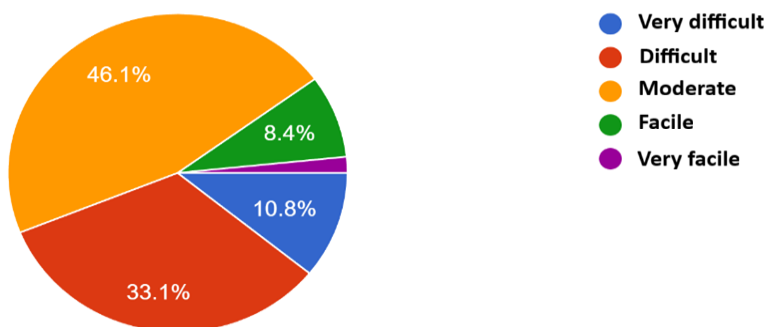


Fig. 5 The complexity of the application process

Almost half of the respondents stated that the application process was moderately complex and only 10% of them considered it easy and very easy. The major issues identified were the lack of specialized human resources, the public procurement documentation, the deadline and the technical and administrative requests. The fact that the application had to be exclusively online on the dedicated digital platform did not represent a challenge.

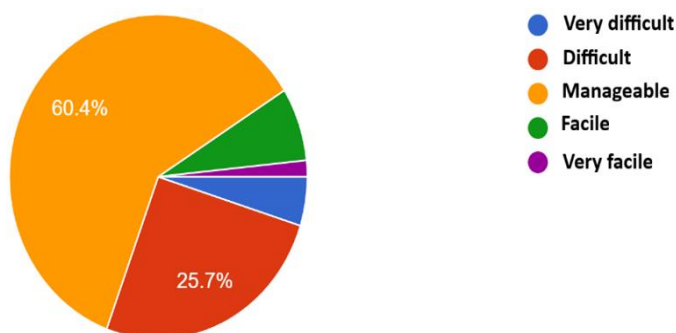


Fig. 6 Overall experience

More than 50% of the representatives of the beneficiaries identified the general experience as manageable.

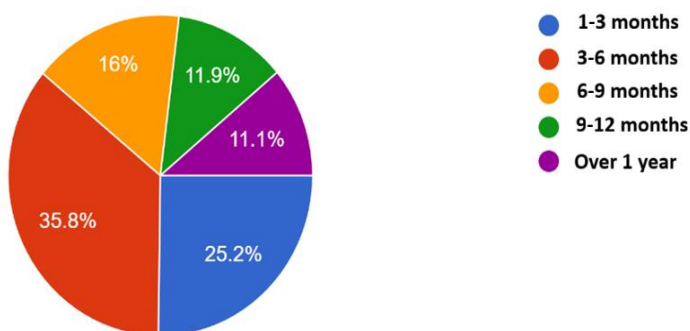


Fig. 7 Duration of procurement start

Only a quarter of the beneficiaries initiated the public procurement procedures in the first 3 months, while the majority started them after 3 months and more.

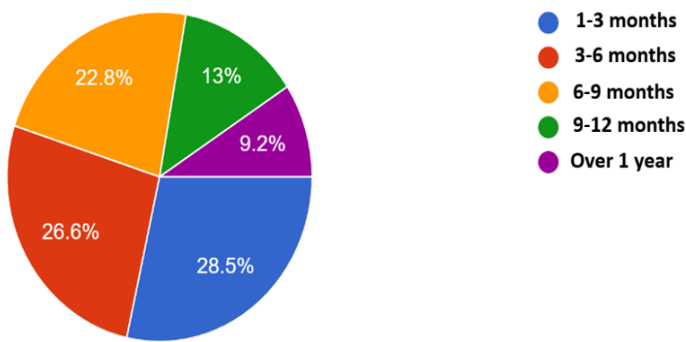


Fig. 8 Duration of procurement completion (until contract signing)

Less than a third of the beneficiaries finished the public procurement procedure in less than 3 months. The main challenges were the lack of expertise, the insufficient human resources and the delays in the equipment delivery.

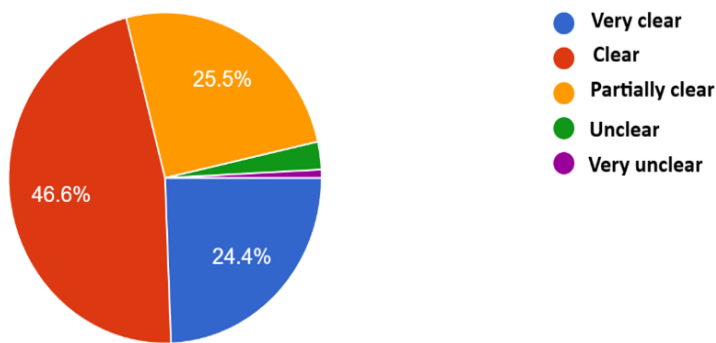


Fig. 9 Clarity of guidelines from UEFISCDI

The majority of the respondents consider that the guidelines from the contracting authority were clear and very clear, less than 15% having difficulties with understanding it.

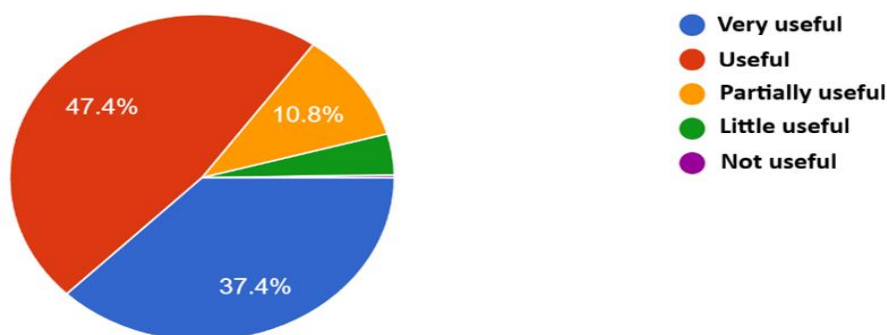


Fig. 10 The usefulness of the support offered by UEFISCDI

Connecting the responses with the evidences from the previous question, the results show that over half of the studied beneficiaries consider useful and very useful the support provided by the contracting authority during the implementation process.

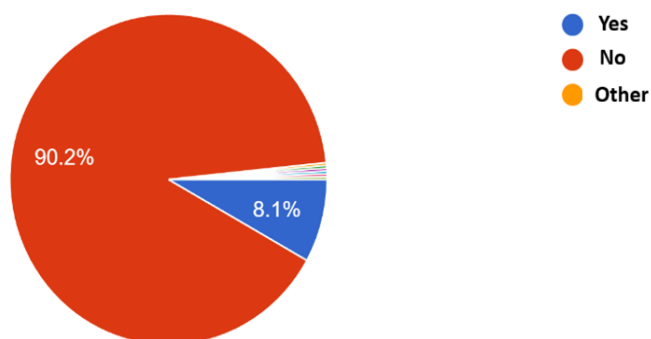


Fig. 11 Difficulties communicating with the financier

From the respondent's perspective, there were not difficulties in the communication with the contracting authority.

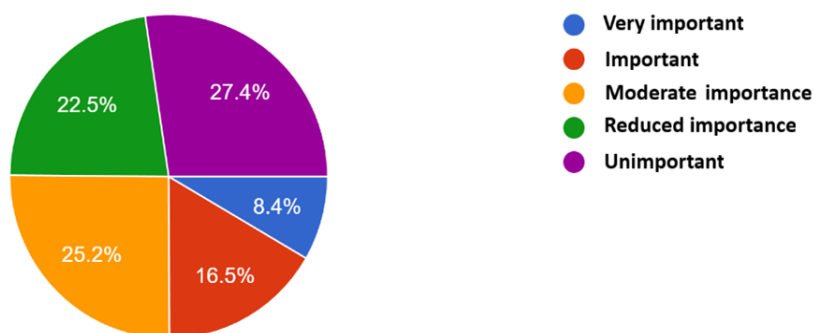


Fig. 12 CSI involvement

Related to the involvement of the County School Inspectorates (CSI) in the project implementation, the beneficiaries did not consider it very significant. The role of County School Inspectorates was mostly for distribution the information and monitoring, rather than offering technical assistance.

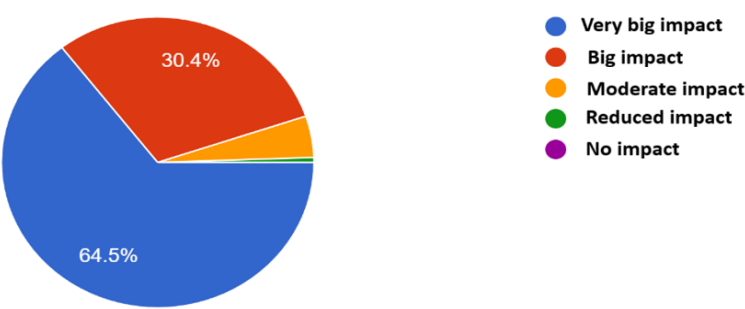


Fig. 13 Smartlab contribution

More than 90% of respondents believe that the reform had a big or very big impact by increasing the pupils’ interest, developing digital competences, improving the teaching act and creating innovative teaching methods and partnerships.

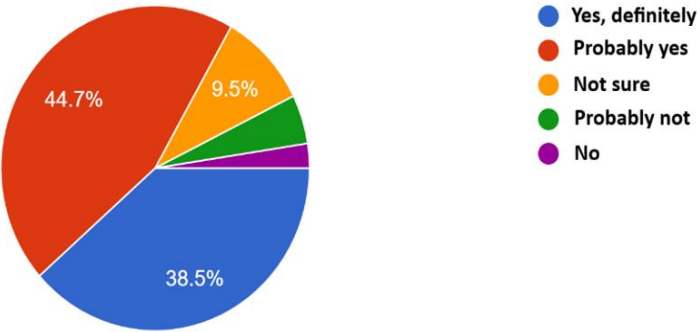


Fig. 14 Availability to reapply

As seen in the chart, many beneficiaries are willing to apply again proving that despite the challenges they faced, the impact of the investment prevailed.

6. Conclusions

6.1. Report conclusions

The analysis of the data collected and the responses provided by the beneficiaries outlines an overview of how European-funded investment programs are implemented in the Romanian education system, highlighting both the positive effects of the investment and the structural limitations that affect the efficiency of the process.

A major finding is that upgrading educational infrastructure is almost unanimously seen as an urgent need and a rare opportunity for schools. Beneficiaries considered the funding valuable for both developing students' digital skills and improving teachers' skills. But as urgent as the need to fund the system is, the journey from writing to implementation is also difficult, as beneficiaries need constant support from institutions with expertise in this area, as they lack these skills. The study shows that despite the support received from the funder, without the constant involvement of a consulting firm, they would not have been able to successfully complete the project.

Registration delays in procurement procedures are closely related to the beneficiary's capacity but also the financier's capacity to empower the beneficiary in their development and management.

This research provides a solid basis for redesigning future funding programs and their implementation, suggesting the need for tailored, context-oriented approaches, with greater attention to spillover effects and territorial differences.

6.2. Future research directions

As a future research direction, it would be very useful to study also the units that could apply for investments in ITC equipment but did not submit a project and to understand the causes, to find potential patterns. Also, there were not analysed the beneficiaries that withdrew from the contract, either from the beginning or later during project implementation. Although these cases are isolated unlikely to reflect a widespread phenomenon because it could be a consequence of certain internal factors rather than of external variables, it is important to identify even these causes because may confirm the conclusions that we had related to institutional capacity.

It would be also interesting to collect and analyse data on the perceptions of teachers using smart labs, the pupils benefiting from these investments and the digital skills they develop, as well as the perspectives of their parents. We consider it is absolutely necessary to include all these perspectives so we determinate the contribution of these projects to a real modernisation of the Romanian educational system. Continuing the research efforts at this level of complexity may be challenging, particularly regarding resources, as thousands of subjects must be surveyed in order to have a representative sample that allows us to generalize the conclusions. Additionally, the variety of forms of organisation of the beneficiaries. Even if the eligible units were upper secondary education institutions, some of these also have classes for lower secondary school, primary school and even kindergarden. This administrative issue may lead to errors in defining and measuring the indicators since access to smart labs is determined independently by each unit.

Another research direction that may be valuable would be studying the complementarity of the smartlabs development reform with other initiatives that aim to improve the digital skills in schools.

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