

High and Higher Education Associates to Meet Market Demands: A Case Study of the Brazilian Health Sector in the City of Lagoa da Prata

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Abstract.

The appointment scheduling process is one of the biggest challenges for the provision of medical services by the public sector. However, this can figure as a challenge, which is the basis for an opportunity for a differentiated case study for high school and college students. Thus, the main objective of this research is to demonstrate a case study of a modeling process of an appointment scheduling confirmation's software, developed by students of the aforementioned student groups, to meet the demand of the city of Lagoa da Prata, a city of approximately 46 thousand inhabitants. Methodologies such as Canvas, BPMN (Business Process Model and Notation), Scrum were used during the research. As a result, in addition to a strategic analysis of the process to be computerized and the modeling of a software prototype for scheduling, a partnership was started with a large company called Vivver Sistemas to invest in research into relevant solutions that boost the search. As contributions, there was the experience of a real project with a team of multiple levels of education, the project of a viable tool and demanded by an entire area of a city. As a differential, the proposed teaching methodology was an option for student engagement, facing the challenge during the COVID-19 pandemic and the difficulties it imposed on teaching. Thus, a relevant tool for the scheduling problem, as well as possibilities for expansion to optimize medical care were envisioned.

Keywords: Business Process Model and Notation, Canvas, Mobile Solutions, Teaching Practices, Public Sector

1. Introduction

The hospital and population care sector in the health area is one of the prerogatives of a health service to the population. Article 196 of the Federal Constitution recommends: *“Health is everyone's right and a duty of the State, guaranteed through social and economic policies aimed at reducing the risk of disease and other aggravations and at universal and*

equal access to actions and services for its promotion, protection and recovery” (Azevedo, 2020).

According to Cardoso (2021), currently the scheduling of consultations in the area of public health (SUS) faces several problems, among which we can highlight the delay in service, many people on the waiting list. Thus, every hospital, UBS (Basic Health Unit), needs to optimize this task, within a strategy focused on patient satisfaction and on the evolution of care. Such optimization also provides the administration of strategic data for this function in the hospital sector. Some suggestions would be the implementation of new technologies that facilitate the entire process of scheduling appointments (Avellaneda et al., 2020). One cannot fail to offer more acceptance and credibility as the health sector is a very delicate area. All care in the health area starts from the moment of scheduling appointments, as it is the patient's first moment with the institution. An optimized process generates fewer errors in this task, so patients are treated quickly and with quality, which generates greater satisfaction and consequently greater productivity.

Focusing on this intent, one can consider standards for process definition, such as Canvas and BPMN (Business Process Model and Notation), which is highly widespread in the industry in general for modeling and portraying processes (Cortez et al., 2020). This perspective can also be combined with the development of Information Systems and Web platforms that consolidate data, generating relevant information for management (Bittar et al., 2018). Several solutions with the application focused on recording data in the health area have already been implemented, focusing on different types of analysis, in addition to formats both in applications and highly complex web systems (Bittar et al., 2018; Souza et al., 2021).

Parallel to this scenario, teaching, whether at high school or higher, demands problems and challenges, with situations that lead the student to make decisions and propose solutions. The challenge of meeting a demand for a systematized application to manage appointment confirmations and cancellations can motivate students during their studies, with an interaction between the school levels described, in a city in the interior of Minas Gerais of more than approximately 46 thousand inhabitants (Da Silva et al., 2017; Portal Lagoa da Prata, SD).

Thus, the general objective of this article is to demonstrate the case study of a modeling process of an information system focused on the city of Lagoa da Prata, to optimize the appointment scheduling confirmation process. To this end, some specific objectives are outlined: firstly, a modeling and validation of the scheduling process in place to analyze the processes and data involved; then demonstrate a requirements gathering process to align the demands that an information system must meet; present the construction of a minimum viable product for validation; and discuss the project validation process with stakeholders representing the health area of Lagoa da Prata.

It should be noted that all students, from high school and college, participated in the entire project.

This research is justified by the demand for quality in the service of the public health service and by the possibility of boosting secondary and higher education with real cases and application of their knowledge in a current demand. In addition, this project is an option to

help teachers to engage students, which is one of the main challenges facing the teaching scenario during the COVID-19 pandemic. (Hermanto & Srimulyani, 2021). This initiative was proposed (a priori) by Inova Lab UNA Lagoa da Prata, in partnership with the Health Department of Lagoa da Prata. One of the successful achievements (and results) is the partnership started with the company Viver Sistemas (to be described during the research).

2. Methods

This work appears as a case study, where a real problem is described and submitted to a solution based on the literature, with evaluation of solutions applied to the context (Smarandache et al., 2020).

First, a procedural modeling process was carried out, based on BPMN to define the scope of service that can be applied to a booking confirmation system. A priori, an automated process was not considered. Such modeling was submitted to the evaluation and validation of the health department of the city in question. In addition, a Canvas was developed (using the adapted model, authored by Souza et al. (2020) - a reference Canvas is described in Figure 1 and the adapted one is shown in Figure 2) for the implementation demand of an application/system.

In a second step, a conceptual modeling process of an information system that could handle the demands that the process presents was carried out. The data to be recorded, possibilities of sequences of use, interactions with users and other issues that could support the basis of the proposed system were evaluated.

Finally, the prototype was developed to present optimization possibilities. After the system was modeled, it was presented again to the health department, where the negotiation process for integration with the current system was initiated.

Figure 1: Canvas



Source: (Dias & Azevedo, 2020)

Figure 2: Adapted Canvas

What types of users will be on the project?	Expected tool contributions:	General Purpose of the App/system:	App/system challenges and risks:	What statistical and strategic analyzes can be done using the app/system?
What use cases will be in the project?			Challenges and Risks of the data analysis that will be made possible:	
What use cases will be in the project?	Challenges and Risks of the Tool(s):			
What data is managed in the project?	Scientific references for the problem:	Scientific References for the Tool(s):		
What works are related to this proposal?				

Template desenvolvido por
 Prof. Dr. Flávio Souza Lattes: <http://lattes.cnpq.br/4111795897515753>
 Profa. Msc. Rafaela Moreira Lattes: <http://lattes.cnpq.br/1207202817257723>
 Profa. Dra. Samara Leal Lattes: <http://lattes.cnpq.br/4919443884503279>

Source: (Souza et al., 2020)

3. Results

3.1 Primary Process Analysis

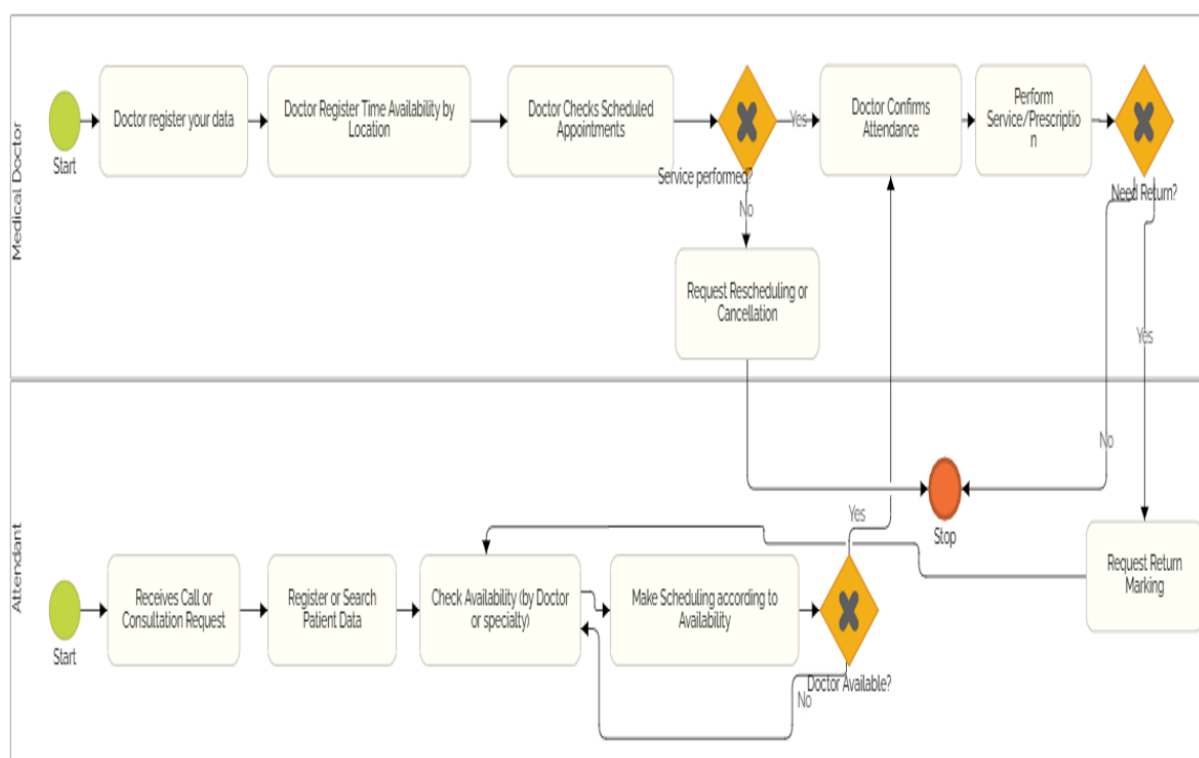
First, an evaluation of how and a brief process of scheduling appointments was carried out. Figure 3 shows a process modeled via BPMN. As can be seen in Figure 1, two references lead the appointment process, the doctor and the Service (a sector present in the clinics).

In an initial analysis, the doctor has the premise of his availability offered to the clinic, which is combined with the demands of appointments that the clinic's attendance demands. As described, it is an approximate, generic process, but it could lead to further analysis of the prototype to be developed. In a previous alignment with the health secretariat of Lagoa da Prata, it was verified that during this process, a latent demand was some agile solution for the consolidation of confirmation data and appointment cancellation. Since, when an appointment is cancelled, it generates operating costs (losses) for the clinic (and consequently for the city).

It was identified that there is a current system that consolidates the data of Lagoa da Prata markings, managed and provided by the company Viver Sistemas. In this case, the data to be managed by the solution to be proposed in this article must consume the data of this current structure. It is possible to notice that there is the premise of appointments that may or may not occur, according to the availability of the doctor or specialty. With this BPMN in hand, an analysis was carried out via Canvas (Adapted) to consolidate the requirements of the application to be developed, as shown in Figure 4.

In the Adapted Canvas, the demands, contributions and risks that the application could offer could be consolidated. In a brief summary, the application will be able to contribute with the city and with the system provided by Viver, in order to consolidate the data, in an agile way for the realization and monitoring of confirmations and appointments.

Figure 3: Modeling via BPMN of the approximate query scheduling process



Source: (Authors, 2022)

Figure 4: Adapted Canvas For solution design

What types of users will be on the project? Patient Doctor Attendant	Expected tool contributions: Appointment scheduling and cancellation management Minimization of costs with canceling appointments Contribute to the strategic management of consultations Optimize patient/clinic contact	General Purpose of the App/system: Manage appointment confirmations for clinic networks in Lagoa da Prata	App/system challenges and risks: Consistent connection with Vivver's system; Accommodation; Compatibility	What statistical and strategic analyzes can be done using the app/system? completed queries Canceled Inquiries Specialty that cancels the most most confirmed specialty Doctor cancellations and confirmations Days and times with the highest cancellations Number of cancellations by time period
What use cases will be in the project? Consume the API with queries of the day Confirm Consultation Cancel Consultation Generate Report /Dashboard To monitor			Challenges and Risks of the data analysis that will be made possible: accuracy; Meet GDPR(LGPD)	
What data is managed in the project? Patient (Name, CPF, Mobile, e-mail); Doctor (Name, CPF, Specialty, CRM, Mobile, e-mail); Consultation (Date, Time, Specialty, Clinic, Patient, Doctor); Clinic (Name, Address); Specialty (Name)			Challenges and Risks of the Tool(s): Platform compatibility	
What works are related to this proposal? CELUPPI, Ianka Cristina et al. PEC e-SUS APS online appointment scheduling system: a tool to facilitate access to Primary Care in Brazil. <i>Ciência & Saúde Coletiva</i> , v. 26, p. 2023-2034, 2021 dos Santos Cordeiro, Tauani, et al. "NÃO COMPARECIMENTO ÀS CONSULTAS ESPECIALIZADAS É UM RESULTADO INDESEJADO DO PROCESSO DE REGULAÇÃO." <i>Arquivos Catarinenses de Medicina</i> 49.4 (2021): 25-40.		Scientific references for the problem: DE ALMEIDA, Spártaco Galvão Fogaça et al. Agendamento on Line de Atendimentos de Saúde Uma Solução em Software Livre para Campinas-SP. POSTAL, Lucas et al. Sistema de agendamento online: uma ferramenta do PEC e-SUS APS para facilitar o acesso à Atenção Primária no Brasil. <i>Ciência & Saúde Coletiva</i> , v. 26, p. 2023-2034, 2021.	Scientific References for the Tool(s): CANTELON, Mike et al. <i>Node.js in Action</i> . Greenwich: Manning, 2014. DA ROSA MÜLLER, Gabriel; SOARES, Inali Wisniewski. <i>Estudo Comparativo Sobre Ferramentas de Desenvolvimento Multiplataforma para Aplicações Móveis</i> . Prof. Dr. Flávio Soares Lattes: http://lattes.cnpq.br/411795897515753 Profa. Msc. Rafaela Moreira Lattes: http://lattes.cnpq.br/1207202817257723 Profa. Dra. Samara Leal Lattes: http://lattes.cnpq.br/4919443884503279	

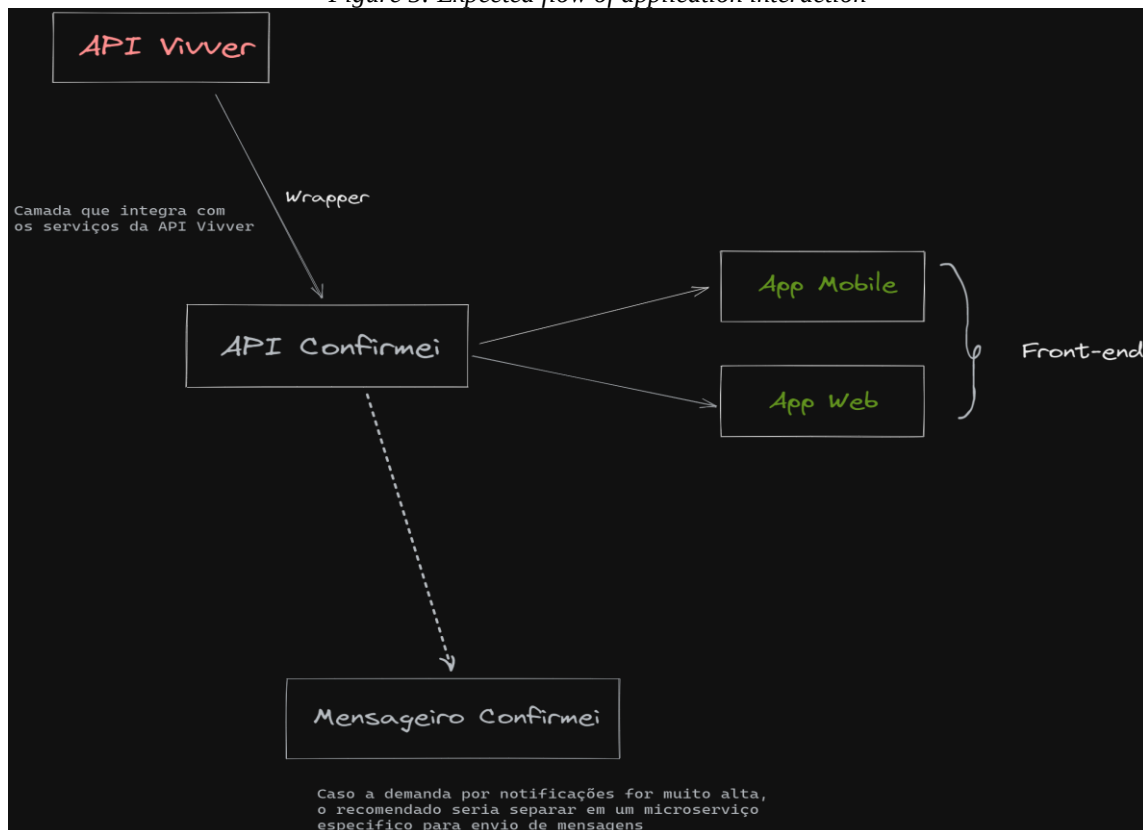
Source: (Authors, 2022)

After evaluating the possibilities, two approaches were followed. First, an initial contact was made with the supplier company Vivver to evaluate the possibility of integrating the solutions, with the proposal of data consumption of the current system by the proposed solution. Confirming the possibility, before a validation by the company itself, an initial prototype was developed by the team (high school and university students), considering the use and an API, to be validated by the company.

3.2 Prototyping

Aligned with the demands with the health department, a prototype was developed, with the objective of demonstrating the feasibility of the solution both for the health department and for the company Viver. The prototype was called "I confirmed". Confirmei will be responsible for managing the information and requests received by the Viver API, it will also send requests to the confirmed messenger, forward the SMS and emails if necessary, the Confirmei API will be responsible for forwarding and processing the data to Front- End (App Mobile, App Web), follows the project scope below in figure 5.

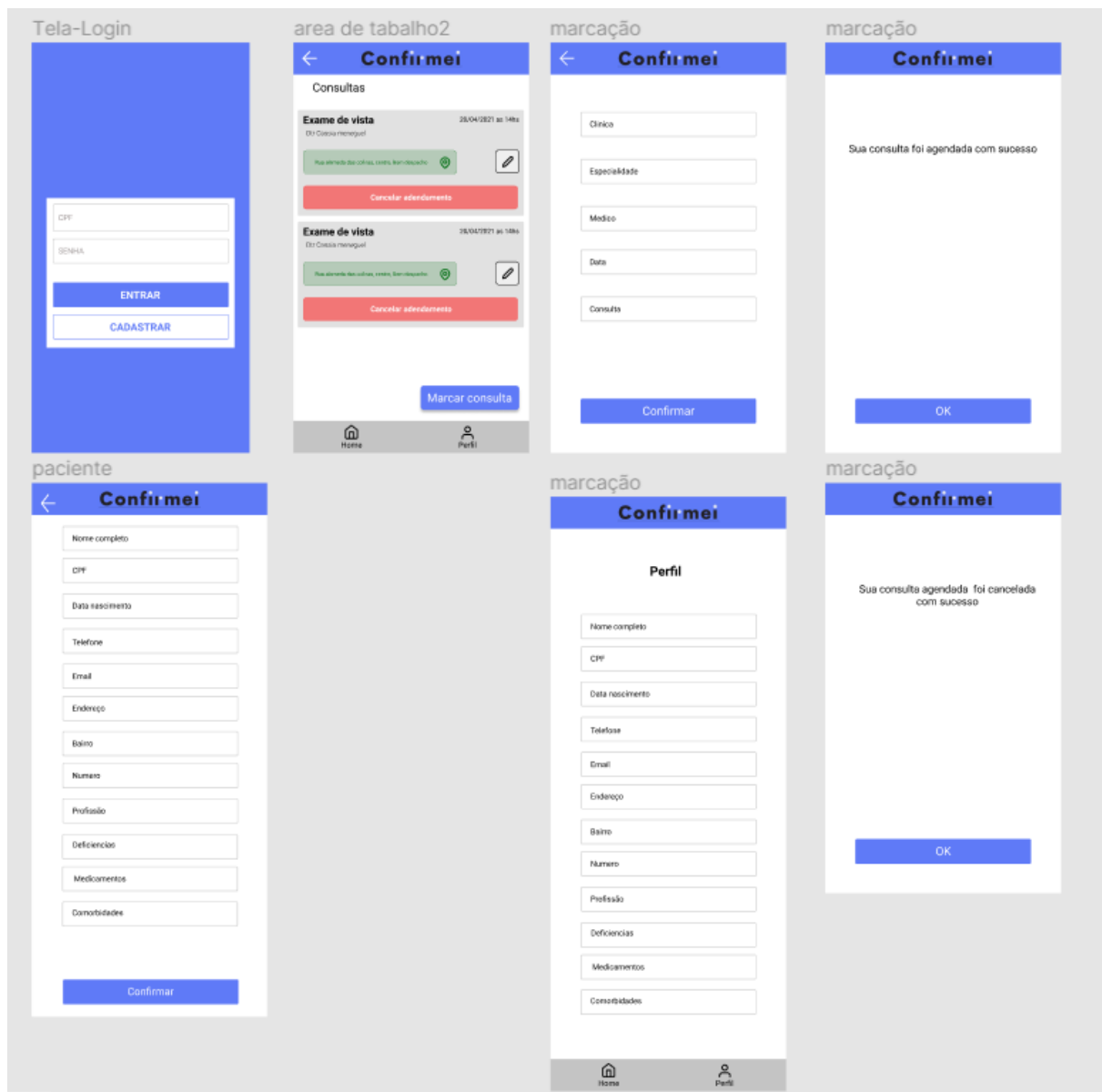
Figure 5: Expected flow of application interaction



Source: (Authors, 2022)

The screens (Figure 6) are initial versions and may be adapted according to the partner. The home screen was developed with simple commands and without excessive information, which facilitates the use of the application. This interface allows the user to log in to have access to confirm the scheduling of their appointments. In addition, if you do not yet have a record, the individual can register as a patient or health professional, being directed to a new page, where they must fill in their data.

Figure 6: Prototypes Screenshot



Source: (Authors, 2022)

Initially, the patient must register using the physical person registration number (CPF), full name, e-mail and telephone, as well as their residential address, as shown in Figure 6 – Patient Registration.

Then the patient must save this information and is redirected to the home page, where he will login (Figure 6- Login Screen). When logging in, the patient will be directed to his consultation panel where he has the option to "Make an Appointment", when clicking, he will be directed to a new screen where he must fill in the data of his consultation and click on "CONFIRM" where he will direct the confirmation screen, and you will receive an SMS or E-MAIL with the confirmation.

In this prototype we also have other features such as unmarking the query, and the user can also change some of their personal data. And the screen being responsive also for desktop version.

3.3 Initial Validation and Contribution Estimates

At the end of the modeling, an initial validation of the process was carried out with the company Vivver. The feasibility of using an API to be provided by the company and an orientation process regarding its application were analyzed. The complete feasibility was verified, since the necessary API already exists, leaving a second moment to adapt the prototype to the data standards managed by Viver. In this case, the same will be done, with due evaluation of deadlines and school calendar, since it appears as an initiative in association with teaching.

During the meetings, the Inova Lab UNA Centro Oeste initiative and growth prospects were presented. It was described the formation of the team that will implement the solution, its mixed composition between high school and university students, and the possibility of partnerships for solutions that will promote the contribution with the city of Lagoa da Prata, in addition to contributing to their formation, thus initiating a partnership to foster research into technological solutions, not only for the proposed project, but for future demands to be provided by the company.

Regarding the development of the application, it is expected that it will contribute significantly to the management and optimization of the scheduling and cancellation of appointments in medical clinics, as well as to the minimization of costs, since the patient/clinic will be able to confirm or cancel the appointment in advance, which allows the clinic to better schedule itself in relation to the doctor's demand for appointments. With this, it is also possible to connect patient and clinic without having to go to the clinic to confirm the service.

In addition, with the application, you can have static data, such as: number/percentage of consultations completed and/or canceled, medical specialty with the highest rate of confirmation/cancellation, days and times with the highest cancellation, number of appointments/cancellations per period of time. Such data can be used for future studies, as well as for company management.

3.4 Perceptions and Contributions in Teaching

As described in the discourse of the work, the research was conducted by high school and higher education students. Higher education students were given the opportunity to experience the practice of what they learn in the classroom, such as driving, modeling and the challenges of implementing a real project.

Now, an issue of considerable relevance is the opportunity for students who are not yet in higher education to experience such a moment.

In a statement by one of the high school students, the contribution that the experience brought was seen: *“About my experience for the first time, I was participating in a project like this! Being a high school student, I was very surprised, I got to know and learned several things that, without this opportunity, I could not possibly acquire. My challenge in this project was really working with people, who were already in the know without a doubt. More people I liked a lot, and the most interesting thing and that will mark a lot is: teamwork”*.

With the resumption of the project ahead of the school calendar, the aim is to carry out the continuity of the necessary adaptations and implementations, in partnership with the new support, Vivver.

4. Conclusion

The research proved to be very satisfactory on several levels. The practical teaching, the experience of difficult moments and teamwork was of a differentiated character for the learning of the students involved. In addition, a prototype with real application possibilities in the market of a city was developed and is in the process of evolution and growth.

During the research, not only tooling issues were explored. There were moments of immersion and negotiation with partners (companies and the public sector), enriching student learning and bringing the benefit of a functional tool to support the public service.

In short, it estimated even more positive results, both technical and procedural, for the development of the research.

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