ABSTRACT

Service-Learning (SL) is a powerful methodology to acquire competences and values in Higher Education. However, there is still no widespread use in Information and Computer Science (ICS) degrees where most of the subjects are focused on the development of theoretical and practical contents purely related to technical competences. In this paper, we show the structure of a SL methodology to develop Bachelor's Thesis: 1) definition of proposals considering all the competencies of the Bachelor's Thesis subject and the needs of entities; 2) development of applications using agile methodologies, and 3) assessment of the SL experience from students, entities and professors. We present an experience developed in the 2019/2020 academic year with two entities devoted to disfavoured people. The results show both the high technical and professional quality of the projects and the high satisfaction of entities and students. We hope that the development of applications with the collaboration of non-profit entities allows the acquisition of both specific and transversal competencies on ICS degrees at the same time enhancing the development of useful professional ones.

Service-Learning Methodology to Develop Bachelor's Thesis in Information and Computer Science Degrees

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Introduction

Service-Learning (SL) is a pedagogical model that integrates community service with curricular learning. In SL, students actively participate in an authentic service activity that meets the real needs of a user group served by a community partner, usually a non-profit entity (Nejmeh, 2012). As was shown by Astin et al. (2000), the participation of students in SL projects leads to positive effects in many important aspects, such as the academic performance, leadership abilities or social values. Moreover, students involved in this type of projects show great satisfaction after completing the SL activities (Buch, 2008), and they appreciate the opportunity of helping other people and consider the service as a personally meaningful experience (Astin et al., 2000; Jacoby, 2014).

In the context of Higher Education, some previous experiences have shown that collaboration between university and special needs groups enables students to acquire social competencies and values, fosters community relations, and contributes to citizenship education (Hebert & Hauf, 2015; Kahne et al., 2000; Astin et al., 2006). In this sense, universities have valuable

resources to develop SL programs oriented to provide useful outcomes to the community partners and social entities (Bringle & Hatcher, 1996). In addition, SL helps to guarantee the introduction in university studies of the Sustainable Development Goals adopted by United Nations Member States (UDNP, 2015). The 17 goals have been defined to balance social, economic and environmental sustainability in order to provide a shared blueprint for peace and prosperity for people and the planet. Some previous works as Melaugh & Kindschuh (2017), Benning et al. (2018), Castro et al. (2020), Yuhlong et al. (2018) and Seban (2013) have shown the benefits of using SL as a way to teach the students about sustainability and to start collaborations between community partners, local governments and associations.

Since its incorporation into academia, SL has predominantly occurred outside the Information and Computer Science (ICS) disciplines. As proposed by Nejmeh (2012), we use ICS to refer collectively to computer science, information systems, computer engineering, and software engineering. Sanderson (2003) noted that "computer science is not very visible in the service-learning community." In the same way, Adams & Runkles (2004) pointed "while service-learning is becoming more common in college curriculums, it is still noticeably absent from many computer science programs." Like other authors, we believe that the development of SL projects in ICS degrees provides benefits to students because they develop curricular projects with real needs in mind. Hanks (2007) pointed out that "they get to work on real projects rather than throwaway toy projects devised by the professor. This leads to greater student motivation and involvement with the projects." Robinson & Hall (2018) indicated that "the content is highly applied and requires the creation of a (minimally viable) solution for and by the completion of the course."

To ensure that projects are completed in a short time, typically a quarter or a semester, it seems appropriate to use agile software development methods (directly known as Agile). Agile refers to a group of software development methodologies based on iterative development, where requirements and solutions evolve through collaboration between self-organizing cross-functional teams (Beck et al., 2001; Chao & Brown, 2009). In general, Agile promotes a disciplined project management process, a set of good engineering practices intended to enable rapid delivery of high-quality software, and a business approach that aligns development with customer needs. Thus, the combination of Agile and SL seems sufficient to acquire the required technical, professional and social competencies.

In this work, we propose the development of applications (apps) as Bachelor's Thesis on ICS degrees to serve non-profit organizations and to guarantee the acquisition of specific and transversal competencies. We focus our attention on achieving two objectives: 1) the acquisition of the curricular competencies related to Bachelor's Thesis from an adequate application of Agile for solving real problems; 2) student's civic and emotional engagement and, ultimately, education, not only on curricula, but also on etic and social values.

Background

In this section, we review some SL projects developed by universities, but the revision done by Nejmeh (2012) is strongly recommended for more information on SL in ICS degrees.

The Engineering Projects In Community Service (EPICS) represents a great experience in the development of SL projects in Computer Science and Software Engineering (CSSE) that started at Purdue University in 1995. From this year on, several universities have created instances. Oakes & Bagchi (2012) describe a program at Butler University's CSSE department in which, each year, students are enrolled in teams consisting of students and professors from different courses. In 2006, the Humanitarian Free and Open Source Software Project (HFOSS Project) began at Trinity College as a small independent study whose goal was to engage Computer Science undergraduate students by building free and open source software. This project included students from a dozen U.S. colleges and universities (Tucker et al., 2012).
In 2008, Agile Alliance created an Agile Software Factory (ASF) to help developers build applications quickly and consistently using well-known architecture and design patterns. In the ASF, university ICS departments serve as a clearinghouse for software development requests from non-profit entities and continue to provide maintenance and technical support for finished software systems (Beck et al., 2001). The ASF is an interesting way to conduct SL projects: the ASF locates non-profit entities that need software solutions to be developed or receives a request from them; the ASF evaluates their feasibility as a SL project for students in software engineering courses and, once the students complete the software system, the ASF provides ongoing maintenance and technical support services for the non-profit entity.

Chao & Brown (2009) describe six SL projects localized by ASF in autumn 2008, developed by 46 students divided into six groups. The authors reported several problems during the completion of these projects: difficulty in coordinating the team members' schedules, difficulty in maintaining communication with students, and difficulty in completing sprints in a short period. Students and entity satisfaction was assessed through surveys whose results showed, for example, that 100% of the 46 students agreed that they had acquired competencies in the class that were applicable to the real world and five of the six entities strongly agreed that they had received the same quality of software as from professional developers.

Other experiences of SL in ICS courses are described in the literature as a collaboration between the university and a non-profit entity, but they cannot be considered ASF. Hanks (2007) describes the experience of transforming traditional practices into SL. The experience was repeated for three years with different results, but Agile was used only in the third year. In the first and second year, only one team successfully completed the project. The other teams did not complete their work due to interpersonal problems within the team (failure to meet commitments, lack of communication, and implicit expectations that someone else would do the work). In the third year, Agile was used to develop the SL project. In this case, the professor had tracked the progress of the project as each sprint ended and all teams finished. Therefore, this work is a clear example of how Agile improves SL project delivery, but we miss an assessment from students and entities about satisfaction.

Robinson & Hall (2018) have described an experiential learning scenario in which blended classroom methodology and elements of SL were employed. The class worked in conjunction with an elderly care entity. The students were tasked with creating a study aid tool for the elderly for the U.S. citizenship test. The work focused on working using Agile, but not on developing a final product. Although some feedback was collected from students and users, no formal method for the assessment of this experience was done.

Motivation

At our university, SL-based experiences started in the 2015-2016 academic year. Eighty-eight proposals on different disciplines have been reported since then. In particular, in the 2019-2020 academic year, eighteen new experiences were developed. We have classified that list taking into account five academic disciplines: Humanities and Arts, Social Sciences, Natural Sciences, Engineering and Architecture, and Medicine and Health.

Figure 1 shows the number of new proposals in the 2019-2020 academic year for each discipline, where the high number of experiences in Social Sciences is apparent. We can also see that there are only two proposals in the discipline corresponding to Engineering and Architecture, being our experience the only one on the area of ICS. In fact, our proposal is the first SL activity on ICS developed in our university.

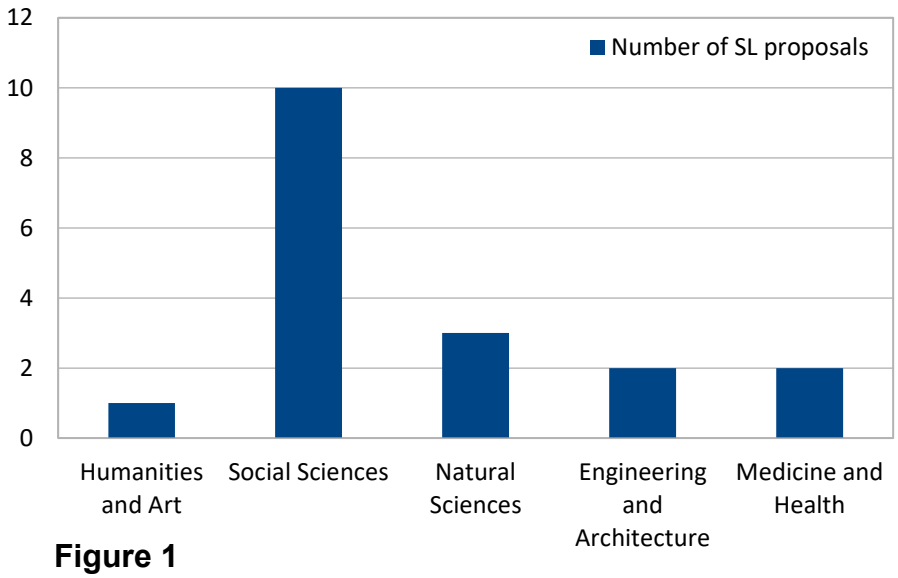


Figure 1

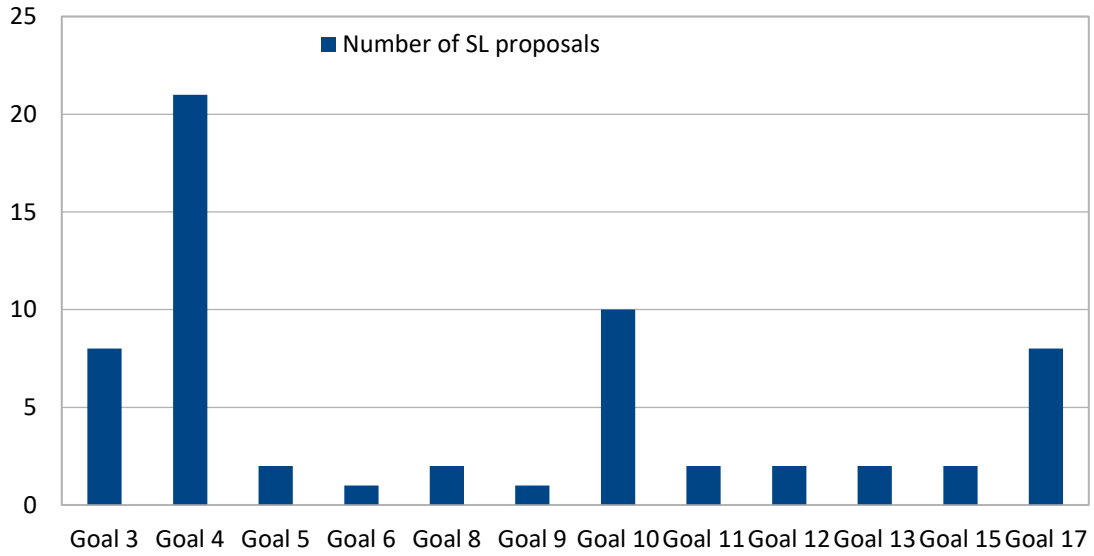
Number of Service-Learning experiences in the 2019-2020 academic year classified by academic discipline: Humanities and Arts; Social Sciences; Natural Sciences; Engineering and Architecture; Medicine and Health

We have also classified these experiences according to the Sustainable Development Goals adopted by United Nations Member States in 2015 (UNDP, 2015). Figure 2 shows the results obtained from the information given by the authors of each

proposal. Most of the proposals are aligned with goal 4 (ensure inclusive and equitable quality education and promote lifelong learning opportunities for all). Other relevant goals are goal 3 (ensure healthy lives and promote well-being for all at all ages), goal 10 (reduce inequality within and among countries) and goal 17 (strengthen the means of implementation and revitalize the global partnership for sustainable development).

Figure 2

Number of Service-Learning experiences in the 2019-2020 academic year classified by the Sustainable Development Goals adopted by United Nations Member States.



In general, the results show that professors of ICS degrees do not get involved in SL experiences. We think that the technical contents given on ICS degrees can be directly used to serve disadvantaged collectives through the development of apps to solve real problems, while at the same time allowing students acquire transversal and professional competencies. In particular, we consider that universities must promote thesis and dissertations aligned with the SL pedagogical model and with the Sustainable Development Goals.

Table 1 presents our analysis about the acquisition of several competencies usually indicated in ICS degrees and the method to achieve them using SL to develop Bachelor's Thesis.

Table 1

Transversal competencies and acquisition using Service-Learning and Agile

Competencies	Acquisition with Service-Learning
Ability to solve problems	The students develop their work taking into account the needs of the target groups.
Teamwork	The development of the projects involves working in a multidisciplinary team.
Capacity for analysis and synthesis	The development of a computer application, its explanation to users and the writing of the report require a great capacity for analysis and synthesis.
Ability to organize and plan	The utilization of Agile makes it necessary to organize and plan the different phases of development.
Concern for quality	Students are aware at all times of the importance of developing a useful and high-quality application.
Ability to generate new ideas (creativity)	The applications must be 100% original, which demonstrates the creativity of students both in terms of functionality and aesthetics.
Express themselves correctly, both orally and in writing	During the work, the students prepare different intermediate documents and participate in meetings. Students also elaborate a final document and give an oral presentation.
To develop for the exercise of an open, cultured, critical, committed, democratic and solidary citizenship, able to analyse the reality, to diagnose problems, to formulate and to implant solutions based on the knowledge and oriented to the common good	Carrying out the work in collaboration with groups of users with functional and cognitive diversity allows us to state that students have achieved this competencie.
Critically evaluate the knowledge, technology and information available to solve the problems they have to face	Students have to select the most appropriate technologies for the development of the application. In addition to using knowledge acquired during the degree, they learned and used new tools and technologies.
Assume as a professional and citizen the importance of lifelong learning	Conducting a Bachelor's Thesis is the first step in facing their future professional life. A project carry out with groups of users with functional and cognitive diversity allows them to have a wider vision of the reality that the one that is obtained with the work done only in the academic scope.

In addition, the use of Agile produces important benefits for the development of these SL projects. Table 2 collects our final conclusions about benefits and limitations of using Agile in SL. However, Agile is not a method for carrying out SL activities and additional tools should be included in the process. For instance, the assessment of curricular contents is done by an external panel of professors and satisfaction of the agents is evaluated using surveys.

Table 2

Benefits and limitations of using Agile in Service-Learning

Service-Learning	**Agile**
Way of involving students, professors and entities	**Benefits:** • Small cross-functional teams, identification of roles and assignment of responsibilities.
Guarantee of acquisition of technical, professional and social competencies	**Benefits:** • Acquisition of technical and professional competencies since students solve real problems using one of the most used methodologies. **Limitations:** • Guarantee of acquisition of social competencies but it needs to develop projects with some entity of disadvantaged collectives.
Academic activity	**Benefits:** • Multi-level planning, which implies adaptation to schedule and time limitations restricted by academic periods. • Continuous testing, which can be used to measure progress and prevent deviations or malfunctions. Surveys could complement that assessment from satisfaction measurements of the involved agents (students, entities and users). **Limitations:** • Evaluation of curricular competencies is not involved.

Materials and methods

We have divided the development of the SL projects in three steps. In the first step, the contact is initiated between all the agents involved in those activities: students, non-profit entities and professors. In the second step, the software product is developed considering the identified needs and using Agile. The third step corresponds to the

evaluation of the experience that requires the elaboration of different surveys considering aspects related to SL and software quality.

Step 1: Identification of needs and entities for the project

Collaboration between non-profit entities and the university is a vital component in SL projects. This collaboration usually arises from the proposals of such entities to improve the daily work with disadvantaged people. The collaboration is established in an agreement that indicates, among others, the following sections:

- SL projects are curricular activities that are developed in the context of university degrees. The projects can, therefore, be developed in any subject, including master's thesis and external internships. It is also possible to develop projects in the context of PhD programs.
- The realization of the projects covered by this agreement does not imply any type of employment relationship between the student and the entity, since the activity developed by students is strictly academic. The activities carried out must be in line with the student's learning and the subject's competencies and they cannot lead to the substitution of professional services.
- The activity carried out under this agreement must not be paid.

We identify the needs of our entities and explain to professionals time and difficulty limitations of the proposal. Subsequently, we propose the project as a Bachelor's Thesis indicating that it will be developed with a non-profit entity. As suggested by Felten & Clayton (2011), the project is defined to guarantee that student's work is aligned and complementary with the curricular goals and expected learning outcomes for that subject. Once the project is selected by students, we must be aware of some aspects, such as student motivation (e.g. previous volunteer activities), personal restrictions (e.g. ease of travel to the location of the entity, number of subjects the student is enrolled in, etc.) and academic time constraints (e.g. expected date of defence). All this information, provided by both the university institution and students, is used to establish a first timetable for the project. Since Agile is studied in ICS degrees during undergraduate courses, the learning of this methodology is not included in our time estimation.

Step 2: Agile project development

Taking into account the needs identified in the previous step and the time constraints indicated by students, we schedule a project duration of approximately three months. Also, three people were involved in each of our projects, taking on different roles:

- Product Owner: a co-supervisor of the project was in charge of ensuring the interests of entities against the development team. This role served as a bridge between both entities and development team transferring needs from one side to the other.
- Agile Master: a co-supervisor of the project oversaw the correct execution of Agile recommendations.

- Development team: in a professional environment the teams usually consist of between 5 and 9 people, but Bachelor's Thesis are usually carried out by only one student.

The projects are divided into several iterations, referred to as sprints in Agile. A sprint is a single development cycle, usually one to two weeks long. Each sprint is reviewed by the development team and potential end-users (in our case, the entity's users) and the knowledge gained from this review is used to determine the next step of development. We planned the following project sprints:

- First sprint: Project preparation, which includes an initial meeting with the non-profit entity to determine the system requirement and the preliminary planning.
- Intermediate sprints (4 or 5 sprints): Delivery of a functional product (as a first scaled-down but functional version of the complete system) to be shown to the entity. The student is responsible for producing release notes to clarify the product performance at each sprint. The entity staff gives suggestions on how to improve the product according to their needs.
- Final sprint: Documentation development, not just a reference manual for the entity after software installation but also the work document corresponding to the Bachelor's Thesis.

Step 3: Project assessment

Since Bachelor's Thesis is an academic activity, students obtain a qualification after finishing the project. They must present a written document and give an oral presentation. A panel of professors evaluates those projects considering the quality of both the written document and the presentation (i.e., acquisition of competencies on oral and written communication) and the technical aspect of the work (i.e., acquisition of specific competencies of the university's degree).

In Bachelor's Thesis developed with SL, it is also needed to evaluate the satisfaction of agents involved in this activity. For that purpose, we define the surveys that both students and entity staff will use to evaluate SL activities when the project ends. Tables 3 and 4 show the questions of these surveys. For the entity staff, we focus our attention on the assessment of the process and the satisfaction with the final product. The survey for students has questions related to their appreciation of the acquisition of competencies and the entire process. The questions are evaluated from 1 to 5 (1: strongly disagree; 2: disagree; 3: neutral; 4: agree and 5: strongly agree). Users who had cognitive difficulties that limited their understanding of the survey or had visual or reading difficulties could carry out an alternative survey based on the selection of a pictogram as answer to those questions, which were verbally posed by a member of the entity's staff.

Table 3

Survey for entity staff

Identifier	Question
Entity 1	The project arises to cover a need of the entity.
Entity 2	The communication between entity and members of the university (student and supervisors of the Bachelor's Thesis) has been frequent and regular to keep everyone well informed about activities and progress.
Entity 3	We have collaborated to establish a shared vision and set common goals to work on the needs of the community.
Entity 4	We have collaboratively established action plans to achieve the specified goals.
Entity 5	We have had the opportunity to share knowledge and understanding of the resources and needs of the community.
Entity 6	We believe that the project will be useful for users of the entity.

Table 4

Survey for students

Identifier	Question
	Curricula Competencies:
Curricula 1	The project has clearly defined learning objectives.
Curricula 2	It is explicitly and intentionally related to the objectives and contents of the subject.
Curricula 3	It will help me learn how to transfer knowledge and skills from the academic context to professional life.
	Social Competencies and values:
Social 4	It will help me to identify and analyze different points of view to improve understanding of social and educational problems.
Social 5	It will help to develop my conflict resolution and group decision-making skills.
Social 6	It will help me to understand and assess the backgrounds and contexts of those who receive the service and myself.
Social 7	It encourages me to recognize and overcome stereotypes.
	Process:
Process 8	During the project, I have been engaged in the idea approach, planning, development and assessment of all the process.
Process 9	I have been involved in the decision-making processes.
Process 10	I have been involved in creating an environment that promotes trust and the expression of ideas.
Process 11	I have been involved in the assessment of the quality and effectiveness of the activity.

In this way, the development of SL activities and the obtained results are analyzed by professors to identify their strengths and weaknesses, and thus improving the activity for the following academic years. In particular, a quantitative analysis of the results obtained from surveys in Tables 3 and 4 are used by us to determine the satisfaction of the involved agents. This analysis of the SL experience completes the evaluation of the acquisition of competencies that, as mentioned, is performed by the panel of professors during the Bachelor's defense and by advisors.

Results

During the 2019-2020 academic year, we developed two SL projects using the method described in previous section. The objective of carrying out these projects with a non-profit entity is to meet the growing demand for computer applications that help the realization of therapies and the daily development of people with functional or cognitive diversity.

The participants of this experience were two students of the degree in Computer Engineering, four professors of the Department of Computer Engineering and one professor of the Department of Physiotherapy, Medicine and Biomedical Sciences. In addition, two different non-profit local entities were involved in the development of these SL projects.

Project 1: Application for game-based therapies

This project was performed as a service to a non-profit organization with four user's services and more than 150 users whose mission is to improve the quality of life of people with cerebral palsy and other related disabilities by defending their rights and supporting families, services to associated entities, and institutional cooperation. Different techniques and tools, including apps, are usually incorporated in intervention with people with cerebral palsy in order to work for the improvement of different aspects of their daily life by contributing to their autonomy (Bax et al., 2005; Pousada et al., 2014) . Based on their knowledge and professional experience, therapists define a set of activities that work certain aspects of these diversities. The results of each session are usually registered for the improvement and monitoring of the evolution of each user. In this context, this first project, entitled "Micro:bit board-based assistive product for people with disabilities", is focused on developing an application that aims to include games in the therapy of people with cerebral palsy. The use of games in therapies allows users to improve both motor and cognitive skills. The application allows therapists to define games adapted to the needs of each user and to track their progress. Due to the motor limitations of these users, the micro:bit board with Bluetooth was used as the interface between users and games. A micro:bit board is an embedded system created by BBC to promote digital creativity (BBC, 2020). All programs can be made using MakeCoder, Python, or Scratch and transferred to the board. The utilization of Bluetooth avoids the use of cables in the room where the therapy is performed.
The project was divided into seven sprints. Most of the sprints lasted one or two weeks, following the recommendation from Agile, although two of them needed one additional week because the student was not familiar with the technologies employed in this

project. Its realization was affected by constraints due to Covid-19: meetings and presentations were done remotely and a single face-to-face test was done with users, among others.

The face-to-face test was performed after the end of the fourth sprint in the entity's building with the participation of the development team, two therapists and two users. A complete therapy was performed, including registration of users, gaming, and analysis of results. Due to the motor limitations of users, communication between student and users was carried out by means of a card with pictograms. It was a very satisfactory experience because the student was able to check the usefulness of the app and, in addition, the feedback from the test allowed him to adjust several application parameters. Figure 3 shows two photos corresponding to this session (at the top) and two screenshots of the resulting app (at the bottom). During a session, the therapist chooses the service using the menu shown in the figure at the left bottom side. The therapist also chooses the game from a list of games associated to this service and determines some parameters: time, sensitivity, objective, etc. All the results obtained during the session were recorded so they could be analyzed or exported. Unfortunately, the pandemic situation caused by Covid-19 made the involvement of the student in the final test impossible. For that event, only therapists and users attended.

Figure 3

Balance board (left) and screenshots of service module (bottom) and game module (right)

Table 5 summarizes the Agile methodology used to develop the project. It was completed on time and the student was able to defend it in September 2020. The evaluation panel consisted of professors of the Information Systems specialization. The advisers do not participate in this process. Following this process, it received a rating of 9.5 out of 10, which leads to an outstanding grade qualification. This work was also presented at a conference for young researchers that provided the student with valuable experience, because it was his first contact with an event devoted to the dissemination of projects in a non-academic context. The project was also finalist for a national "makers" award.

Table 5

Execution of the project "Micro:bit board-based assistive product for people with disabilities"

User's diversity	Sprints	Technologies	Real planning
Cerebral palsy	7 sprints: an initial sprint of 1 week, 2 intermediate sprints of 3 weeks and 3 of 2 weeks, and a final sprint of 1 week	Micro:bit Phyton MySQL	14 weeks Student's work: 300 hours Supervisor's work: 20 hours

The assessment of the SL experience was done by using the surveys described in Table 3 and Table 4. According with the entity staff survey (Table 3), the two therapists answered "totally agree" to all questions. Some additional comments were collected from them:

"This application will be very useful for our users."

"We would like to create our own games."

"It was difficult to keep track of therapies before."

"We have many ideas for other applications."

With respect to the evaluation done using the student survey in Table 4, the student answered "totally agree" to all survey items related to "curricula competencies". On the case of "social competencies and values", the assessment was "totally agree" for all questions except for [Social 5], which was evaluated as "neutral". This question is related to the acquisition of competencies for conflict resolution and decision-making skills. Finally, with respect to the process, the student answered "totally agree" to the [Process 8] question and with "agree" to the rest of them. This student also added the following comment:

> “Working with disadvantaged groups is always a pleasant job, mainly because of the gratitude they usually show towards people who want to help, as has been this experience. The happiness and gratitude shown by the users of the program during the tests, by itself, makes it worthwhile to have taken the time to develop something like this project.”

Project 2: Application for a digital agenda

This project was done as a service to a non-profit organization formed by a group of families with children with functional diversity. Several professionals run home care and intervention programs (psychopedagogic, speech therapy, psychomotor, etc.) for children with Autism Spectrum Disorder, Asperger's Syndrome, Williams Syndrome, Fraxile X Syndrome, Sotos Syndrome, Dandy-Walker, etc.

Autism Spectrum Disorder is a neuro-biological developmental disorder that manifests during the first three years of life and will last throughout the life cycle (Zwaigenbaum et al., 2015). The characteristic that best defines people with Autism Spectrum Disorder is the presence of a distinctive deterioration in the nature and quality of social and communicative development (influenced by the specific biological and environmental circumstances of the individual). Usually, these people have a greater difficulty in learning social and communicative skills but, with the help of specific teaching methods, which are mostly characterized by making social information explicit, they acquire a greater ease in assimilating that information (Lord et al., 2018).

In this context, the second project consisted in the development of a digital agenda for children with Autism Spectrum Disorder. Figure 4 shows several screenshots of the resulting application, which aims to establish the diary routine of children with Autism Spectrum Disorder. The application provides a visual representation of the current tasks or activities for users, and it also helps them to anticipated the following items in their routines. The mobile app was developed taking into account the difficulties of people with that disorder. Thus, the use of pictograms that represent the tasks to be performed throughout the day had great importance. The mobile app can be configured by users, therapists or families through a simple interface.

Figure 4

Screenshots of tasks’ management (two left images) and of routines’ management (two right images)

The mobile app also has a statistics module (Figure 5) that allows therapists or families to visualize the data related to the tasks completed by the user in real time. Thus, the specialists can track the progress of each individual user and adapt the tasks according to his or her needs.

Figure 5

Statistics module of app in project 2

Due to the Covid-19 pandemic, most of the meetings were conducted online, but the student had the opportunity to have two face-to-face meetings with therapists to make a presentation of the app features. Table 6 summarizes this experience using Agile. The project was completed on time and the student was able to defend it in September 2020 obtaining the maxima qualification of 10. In addition, the project was the winner of two awards at our university as the best Bachelor's Thesis in sustainability and development cooperation, and as the best Bachelor's Thesis on ICT.

Table 6

Execution of the project "Digital agenda for children with Autism Spectrum Disorder"

User's diversity	Sprints	Technologies	Real planning
Autism Spectrum Disorder	7 sprints: an initial sprint of 1 week, 5 intermediate sprints of 2 weeks, and a final sprint of 2 weeks	Dart Flutter Firebase	13 weeks Student's work: 300 hours Supervisor's work: 20 hours

With respect to the assessment of the SL experience, three therapists participated by answering the survey shown in Table 3:

- One therapist pointed out an assessment "totally agree" all items, thus showing the satisfaction with work development.
- The second therapist marked the top rating for all of them, except for [Entity 4] and [Entity 6], which were answered “agree”. These are related to the degree of achievement of the specified goals and to the future use in the daily life of the users in the entity.
- The third therapist answered “totally agree” on all but [Entity 5], which was answered “agree”. This is related to the exchange of experience and knowledge on the needs of the users. These results show that more collaboration between all the agents is demanded by the entity and are also understandable since entity and users, used to working with traditional but heavy paper-based planning, have their doubts about switching so radically to a mobile platform.

In addition, some additional comments were collected from the therapists:

> “The statistics module is very useful.”
>
> “The design is very attractive.”

With respect to the evaluation done by using the student’s survey in Table 4, the student gave the maximum qualifications on all items, except for [Social 5] and [Social 7], which were evaluated "agree" with the following comments:

> “I don't see it relevant that my project is directly connected to conflict resolution.”
>
> “On a personal level, in general, I am not a person who has stereotypes, however, when talking with my environment, it helped me a lot to recognize stereotypes that people have that I used to overlook.”

It is important to note that this student was already committed to this group before this work, because he participated as a temporary volunteer in camps of different organizations that worked with children with these kinds of difficulties.

Discussion

The experience described in the previous sections shows that the combination of the SL methodology and Agile to the development of a Bachelor’s Thesis in ICS degrees allows students to acquire transversal competencies and social values. The two Bachelor’s Thesis obtained a high academic qualification. Regarding the satisfaction surveys, all comments received from entity staffs involved in the SL projects were very positive. In fact, project 1 will be used for the four services provided by the entity and project 2 will be distributed with a free-software license. Assessment received from students was also very positive for both projects. They indicated a high degree of

satisfaction, especially regarding the acquisition of technical competencies. For social competencies, the ratings depend on the previous experience of the students. In the case of project 1, this was his first contact with an entity dedicated to people with diversity. The student of project 2, however, was already familiar with this type of entities because he had previously carried out volunteer activities. This fact has strongly contributed to the overall work since he was able to transfer these previous experiences to the design of interfaces for people with cognitive difficulties.

We also consider that higher educational institutions must guarantee that graduates have the knowledge and the skills needed to develop their professional careers facing social problems. In this sense, we want to note that three different sustainable development goals were worked on in the projects described in this paper: goal 4 (ensure inclusive and equitable quality education and promote lifelong learning opportunities for all), goal 10 (reduce inequality within and among countries) and goal 17 (strengthen the means of implementation and revitalize the global partnership for sustainable development).

Conclusions

In this work, we have proposed the development of applications with the collaboration of non-profit entities using a SL pedagogical method. Agile is used to achieve a final product according to time constrains, to stablish continuous monitoring and to identify roles in a multidisciplinary team. An external professors' panel evaluates the work taking into account academic criteria, while the Service-Learning experience is evaluated by students, entity staffs and professors.

Two projects were carried out as Bachelor's Thesis in 2019-2020 academic year, where students had to develop apps to help people with cerebral palsy or autism spectrum disorders. The experience shows that the combination of the SL methodology and Agile for the development of a Bachelor's Thesis in ICS degrees allows students to acquire transversal competences, while Sustainable Development Goals are introduced in ICS degrees. Both projects received high academic scores.

Although the results were very satisfactory, we agree with other authors' considerations about taking into account the additional effort and commitment required to incorporate SL projects to subjects in higher education. For example, Castro et al. (2020), Chao & Brown (2009), and Ruiz-Montero et al. (2020) pointed out that: 1) on the professors' side, this methodology requires extra time for planning and execution and also for the search of an adequate entity that can meet their needs (e.g., asking non-profit entities in the surrounding area to act as community partners, making sure that the partners are satisfied with their collaboration with students); 2) on both professor's and entity's side, it is not easy to reconcile the subjects' schedule with that of the entity; 3) on the students' side, the SL projects must be finished in a limited time (usually a quarter or a semester) and 4) on entity's users, they can have doubts about their participation or not in these projects. In addition, the fact of involving entities may create expectations in vulnerable groups that should be treated with extreme care. The authors of this work consider that this methodology combining learning and community service allows students to acquire competencies that are not considered in other types of projects, and the collaboration with non-profit entities serves to enrich the

values of society. For these reasons, in following academic years, we continue to use the method presented in this paper to develop other Bachelor's Thesis.

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