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Semester of Code: Piloting Virtual Placements for Informatics across Europe

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***Abstract*—VALS (Virtual Alliances for Learning Society) European Project intends to build knowledge partnerships between European Higher Education Institutions and Business stakeholders across the World to collaborate on resolving authentic business problems through Open Innovation and Open Source Software. To conduct these knowledge partnerships, the VALS project leverages the virtual placements, in which students from all European countries can be involved in the resolution of real business problems, developing by this way professional skills, and other business-related attitudes that will help them to enhance their (future) professional career. These virtual placements result in the Semester of Code, which is a set of practices, methods and processes for creating and managing real virtual placements. Following these ideas, this paper is focused in the description of how is designed this Semester of Code, how the VALS partners have developed different tools, guidelines and processes to manage and track the virtual placements and how are performed this set of tools and guidelines in order to achieve the success in the pilot tests of the Semester of Code and its virtual placements.**

Keywords—Virtual Placements, Pilots, Informatics, Open Source Software, Semester of Code; VALS

I. INTRODUCTION

VALS (Virtual Alliances for Learning Society) European-funded project (40054-LLP-L-2013-1-ES-ERASMUS-EKA) has the aim of establishing sustainable processes to build knowledge partnerships between Higher Education (HE) and companies to collaborate on resolving authentic business problems through open innovation mediated by the use of Open Source Software (OSS) [1], which provides the means whereby HE, students and business can all collaborate to resolve real problems. This has great potential for enabling students and supervisors to collaborate in resolving the problems of businesses, but is constrained by the lack of support for managing and promoting collaboration across the two sectors. The motivation behind the VALS project has its origin in a shared need, to forge greatly improved links between HE students and their teachers, and on the other hand the businesses where those students will find employment. Nevertheless, mobility of students in placements and internships in companies relies on the local connections, which HE have developed, and the location of placements is restricted by the high costs of relocation and living expenses at any significant distance from the home institution. The solution is to create virtual placements [2-6]. These will make use of the technology that drives the professional environment to organize and carry out placements. The reason this potential has not been fully exploited is that virtual placements have not to date offered experience of an authentic business environment and business problems. Thus, for the approach to be successful, these aspects need to be replicated in a virtual placement. To achieve this, VALS builds knowledge partnerships between HE and companies who work together on resolving authentic business problems through open innovation [7, 8]. The innovative approach is to leverage virtual placements of Informatics students in companies in order to foster entrepreneurial and professional skills and attitudes, and to make use of the results to establish new learning and teaching methods. This result in the Semester of Code methodology and pilots, a sustainable set of methods and processes for creating and managing virtual placements, and for integrating these into innovative teaching and learning strategies [9].

As previously pointed, the Semester of Code (SoC) initiative allows students of degrees of Informatics addressing real business problems raised by companies and OSS Foundations in an international context, getting rewards from resolving them which will be reflected in their formal education and helping them to develop professional skills that would help in their professional career.

The first pilots for this initiative are being performed between September 2014 and June 2015. The Semester of Code initiative tests two possible action lines about the virtual placements, one focused on managing the entire process of the placements for informatics students, and another more focused on the computer system that will support the achievement of this initiative with all stakeholders.

The paper is divided into the following sections, after this first section, is introduced a deeper description about the Semester of Code (section two, *Semester of Code Description*), including the possible stages for the placements, and the approach and ideas behind the Semester of Code initiative. The third section, *Semester of Code Virtual Placement System*, explains the main features of the web-based system that support the Semester of Code process. The fourth section, *Assessing Virtual Placements*, shows how are planned the assessments within the Semester of Code, how are evaluated the placements (quality, organization, etc.) and how is assessed the work done by the student in the placement in order to achieve the possible academic rewards and the recognition of the placement by the Company or Foundation that proposes the project for the placement. The fifth section, *Semester of Code Pilots*, reveals to the reader how are planned the pilots (both first and second pilot) intended to test the Semester of Code approach, and what are the issues and findings retrieved by the VALS partners by running the Semester of Code. The last section, *Conclusions*, resume the thoughts and insight of the paper authors about the current state of the Semester of Code and the advances made in the VALS project.

II. Semester of Code Description

As previously explained, the Semester of Code is the practical extension of the VALS project, and is based on the ideas and features retrieved from previous projects, initiatives and guidelines not only in the scope of virtual placements, but in the scope of the Education on Informatics (in virtual or physical format) [10-13]. Also, this Semester of Code has been designed following win-win principles, so all possible stakeholders get valuable wins being involved in the initiative [14].

The VALS project has a EU-funded timeline extension of two years, so, after the study and the design of the virtual placements in the first year of the project (2013-2014), it is time to conduct the pilot tests (Semester of Code pilots). The pilots are composed by several phases, in order to make a clear process for the virtual placements, and involve several stakeholders [14, 15]. Following are described the main stages of the Semester of Code pilots:

- Projects poll: In this phase the organizations (Companies/Foundations) submit projects to the Virtual Placement System (VPS) of the Semester of Code website (http://vps.semesterofcode.com). All the projects presented to the VPS must be part of a real business problem of the organization and are revised by the Semester of Code website administrators (members of the VALS project core team), they can reject the projects that don't address the requirements (must be part of a real project, a minimum quality in the proposal, etc.).
- Students' application: After the projects poll phase is the moment for those students that want to participate in the Semester of Code. In this phase, the students review the project proposals in the VPS website and select those they want to solve. Once the student selects the project or project, the student engages an Academic Supervisor (faculty staff) from his/her Higher Education Institution (only HE Institutions on the scope of European Union are allowed to participate in the pilots at this moment). This Academic Supervisor helps the student to prepare a solution proposal (ensuring a minimum quality of the proposal) for the project. This Academic Supervisor will be later the responsible of the student mentoring process from the side of the Higher Education Institution.
- Adjudication of the projects: The Companies and Foundations examine the solution proposals submitted by the students and select the best approach to their problems. This decision will be communicated to the student in order to begin to formalize the student placement. In this phase is not mandatory for the Companies and Foundations to wait until the deadline for the student applications, they can preselect solutions that fit in the problem in any moment.
- Formalization of the students' placements: At this stage, the students negotiate with the Company/Foundation the timeline and the schedule for the project development, and the different features of the final product they will develop (based on the project proposal specifications uploaded to the VALS Virtual Placement System by the Company/Foundation). On the other hand, the Academic Supervisor, the Higher Education Institution and the student fix the academic rewards for the development of this project, as well other academic issues, like timelines for recognize these academic rewards, the academic requirements of the solution that the student needs to accomplish to achieve the academic rewards, etc. These academic rewards as well the professional experience and possible skills gained at the end of the virtual placements will be the rewards achieved by the student, because in this project there is no money involved in the placements.

  Finally, in order to formalize the virtual placement and to be recognized the placement by the Academic Institution, the Company/Foundation sign an agreement with the Institution and the student where they remark the conditions of the virtual placement and the project which student will develop. This agreement is not unique and can be different between the Academic Institutions, because this agreement fix the academic and legal issues to recognize the placement based on the educational system of the country where belong the Academic Institution involved, and these issues change between the different countries in the European Union.

- Finally, the student with the help of the Academic Supervisor and the Business Mentor develop the project and gets the final success, achieving also the academic rewards previously fixed. This stage is reviewed and mentored by both stakeholders, the Academic Supervisor and the Business Mentor, in order to track the student's advances in the project, to help with the different issues that could raise during the development, and to assess the virtual placement and give the rewards to the Student (academic rewards, the placement recognition by the Company/Foundation, etc.).

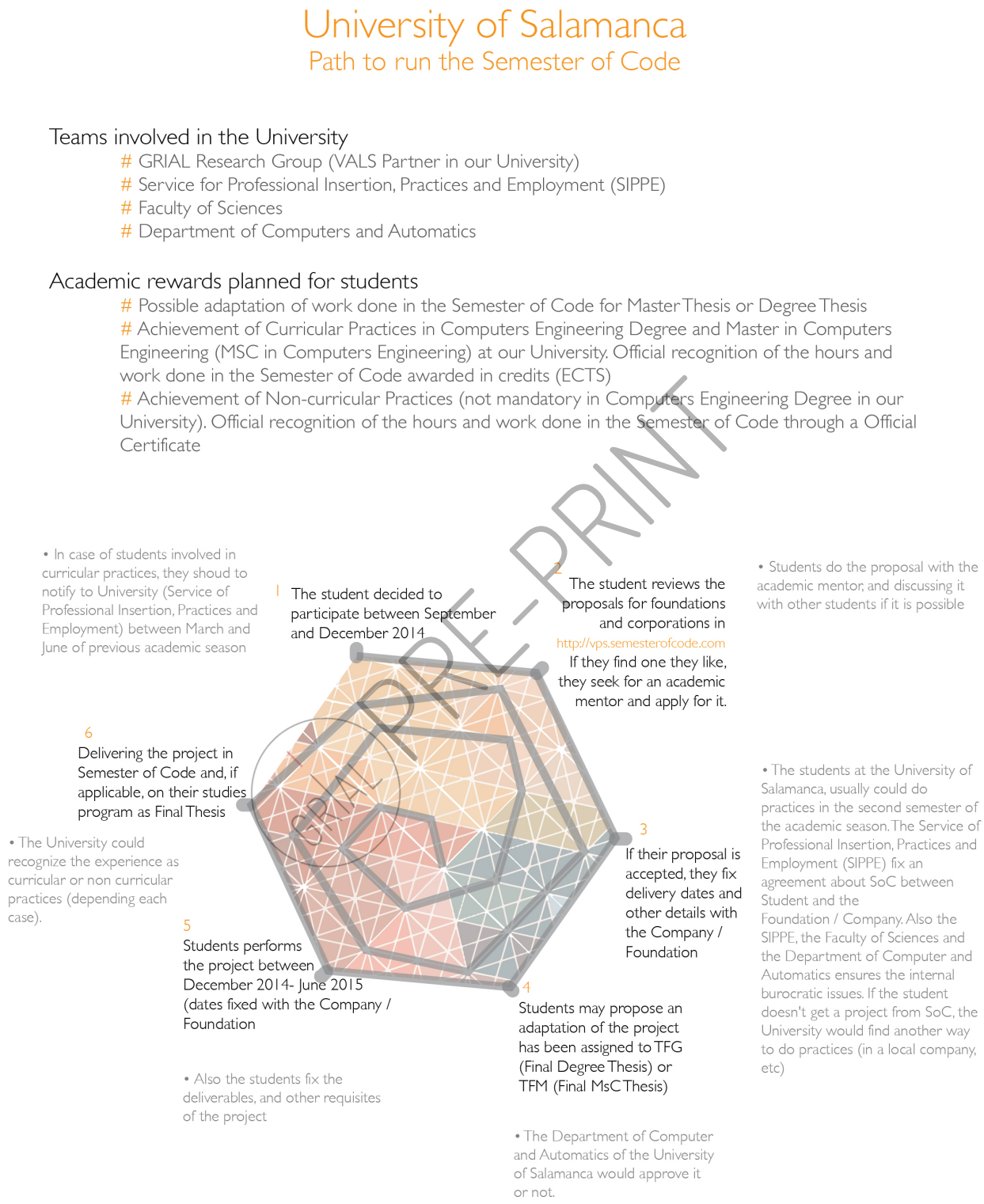

Figure 1. Semester of Code adaptation for the University of Salamanca (Spain)

Due to the knowledge retrieved by the partners from previous experiences and projects, the Semester of Code is articulated in a decentralized way. It is decentralized because the core team of VALS project fixes the main framework, rules and guidelines, and the each Higher Education Institution performs the real approach for the context of each country and each educational system (the possible academic rewards, schedule, etc.), as well they fix the best way with the Companies/Foundations to recognize in their context the Virtual Placements. For example, the VALS core partners specify that the academic rewards are mandatory to award the students' placement, but they do not specify explicitly how must be these rewards, so each Higher Education Institution should establish their rules on giving academic rewards based on their possibilities, the rules of its educational system, etc. In the Figure 1 is show, for example, how the University of Salamanca (Spain) adapts the lifecycle of the Semester of Code in its local context, as well it is specified the University Services and Departments that should be involved in the Virtual Placements, to achieve success and ensure that all the requirements and issues of the Semester of Code are accomplished

In the following section will be described the features and main utilities that implements the Virtual Placement System developed by the VALS partners for managing the Semester of Code.

III. SEMESTER OF CODE VIRTUAL PLACEMENT SYSTEM

To run the Semester of Code it is necessary, besides the work of the Companies, Foundations, Universities, students, etc., the support provided by a system that allows:

- The partners to communicate between them;
- All of them to follow some required steps in the program;
- And even the most important thing, managing online all the process and path of the Semester of Code.

This system is named in the VALS case, the Virtual Placement System (VPS).

The Virtual Placement System is a web-based system (http://vps.semesterofcode.com) that implements the features necessary to develop the Semester of Code. In these features can be highlighted the following:

- To allow multiple roles in the system, such as Organizations (Companies, Foundations, Projects), Institutions (Higher Education Institutions, Universities), Mentors (Business Mentors), Supervisors (Academic Supervisors) and students. The system also controls the actions that can be performed depending on the user role.
- To conduct the Semester of Code path designed by the VALS partners (project proposals, students' application, decision about applications, support to development process, etc.) both in the schedule, timeline, and specifications of each stage of the Semester of Code path.
- To allow managing the proposals, applications, etc. by the personnel responsible.
- To allow tracking the status of each proposal, project, application etc., so each user involved in them can get notifications and information about the decisions, development, or status of the projects in all the possible stages.
- To allow updating the projects, including information about the project outcomes, possible deliverables, code repositories, etc.

The Virtual Placement System does not provide tools for communication like chat, video-chat, etc., only provides communication features and notifications related to the project itself (decisions about the project, notifications about deadlines, some messages between the students and Companies or Foundations, etc.), because the VALS partners decided that the different stakeholders would use the communication systems they usually use and make them feel more comfortable to manage the projects, personal interviews, etc., such as messages in code repositories, video-chat systems (Skype, Google Hangouts, etc.) or simply emails.

At the begin of the project, the Virtual Placement System was intended to be developed using a similar platform that uses Google to manage their similar initiative (the Google Summer of Code [10]), which is called Melange [16]. Finally, the VALS partners rejected to use this platform due to its problems and bugs (at least at the begin of 2014) and started to develop a new platform based on Drupal [17], which is also Open Source like the scope of the projects that the students develop. The Virtual Placement System (Figure 2, Figure 3, Figure 4) uses the resources that Drupal offers and add functionality with a plugin developed by the VALS partners that guide the path, timelines and schedule of the Semester of Code.

This developed plugin includes components like:

- The project list (Figure 2) which presents to the user all the projects proposals introduced in the platform by the Companies/Foundations with data about them like the proposals received, the Company/Foundation that proposes the project, etc. Each item in the list represents a project idea and could be clicked to show detailed information about the idea (Figure 3), including the desirable skills for developing the project, the difficulty, some prospective mentors available for the project, statistics about the idea (number of project proposal submitted by the students, etc.) and the comments (questions, remarks, etc.) that users have submitted for the project idea.
- The Institutions (Higher Education Institutions) list with information and contact details of each one.
- The Organizations (Companies and Foundations) list with information about them and the mentors they provide.
- The users' dashboard with the actions that each stakeholder and user can take. In the Figure 4, for example, is shown the dashboard that uses the

Institutions (Higher Education Institutions, Universities) with different options like:

- *My Institution:* Information about the Institution, contact details, etc. with editing capabilities.
- *Members of my institution:* All the people involved in the Semester of Code within the Institution like the Institution Administrator, the Academic Supervisors and the Students.
- *Groups:* Each Institution clusters the Students in groups in order to administrate their application for projects, assigning students' groups to each Academic Supervisor involved, etc.
- *Overview:* Some statistics and relevant data about the Institution within the Semester of Code platform.
- *Review Project Idea:* Options to review the project ideas provided by the Companies/Foundations. The Academic Supervisors and Institutions can review these ideas before the students apply to solve the projects.
- *Proposals submitted by students from my institute and in my groups:* Option to list and review the proposals submitted by the students to the project ideas presented by the Companies/Foundations.
- *My accepted projects:* List about the students' proposals approved by the Companies/Foundations to be developed within the Semester of Code by the Students that belong to the Institution.

- Information about the Semester of Code and VALS project, including the timelines for the process, news and announcements, etc.

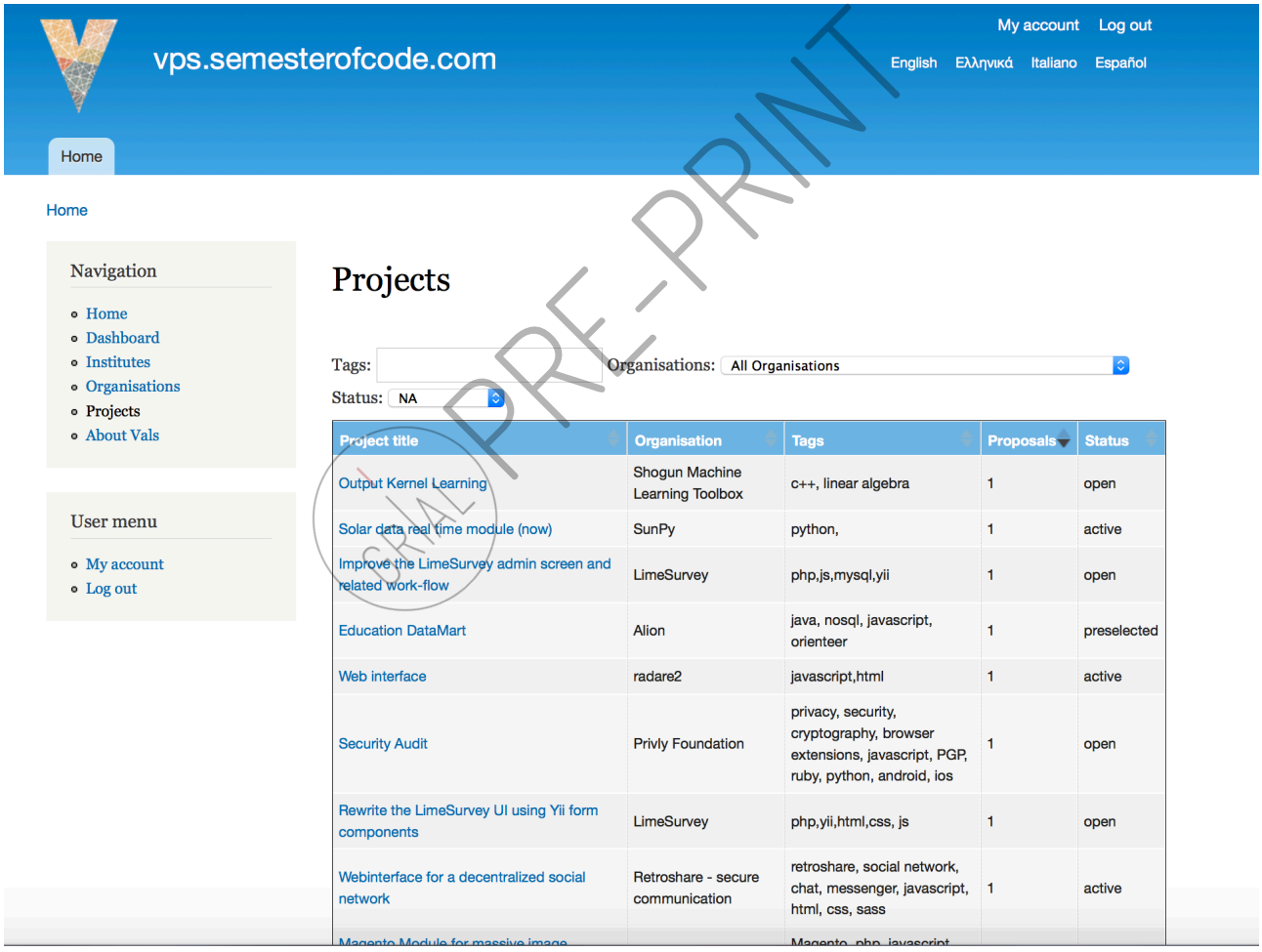

Figure 2. Virtual Placement System layout. Public projects list view

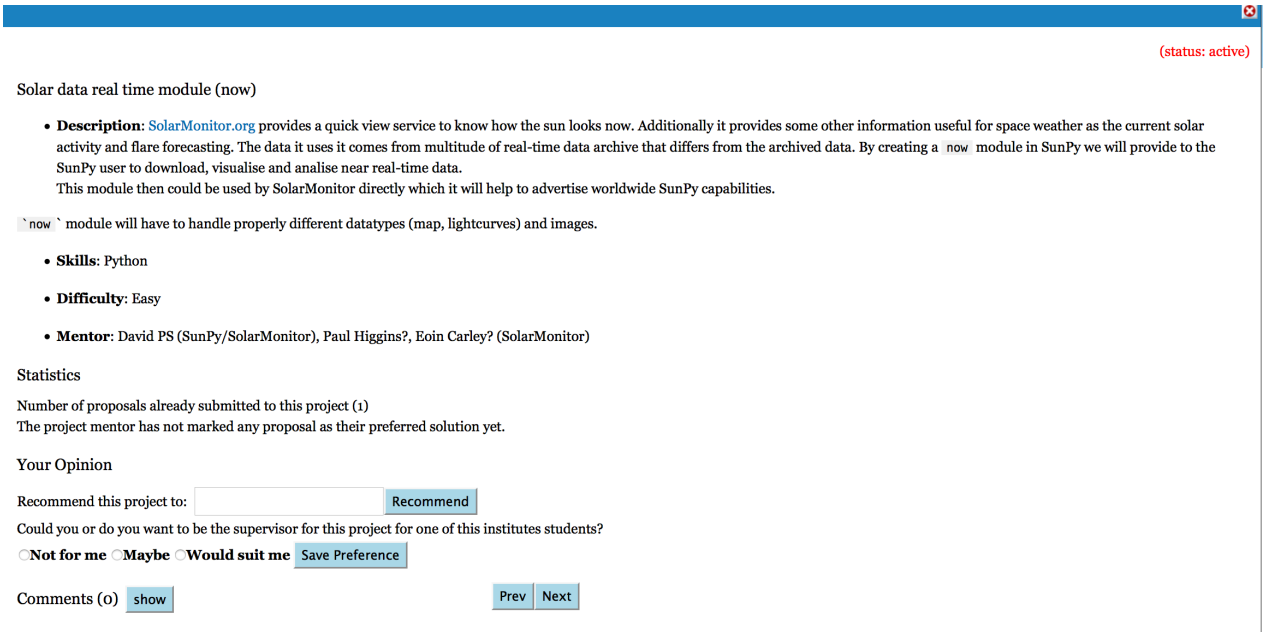

Figure 3. Virtual Placement System layout. Project proposal view

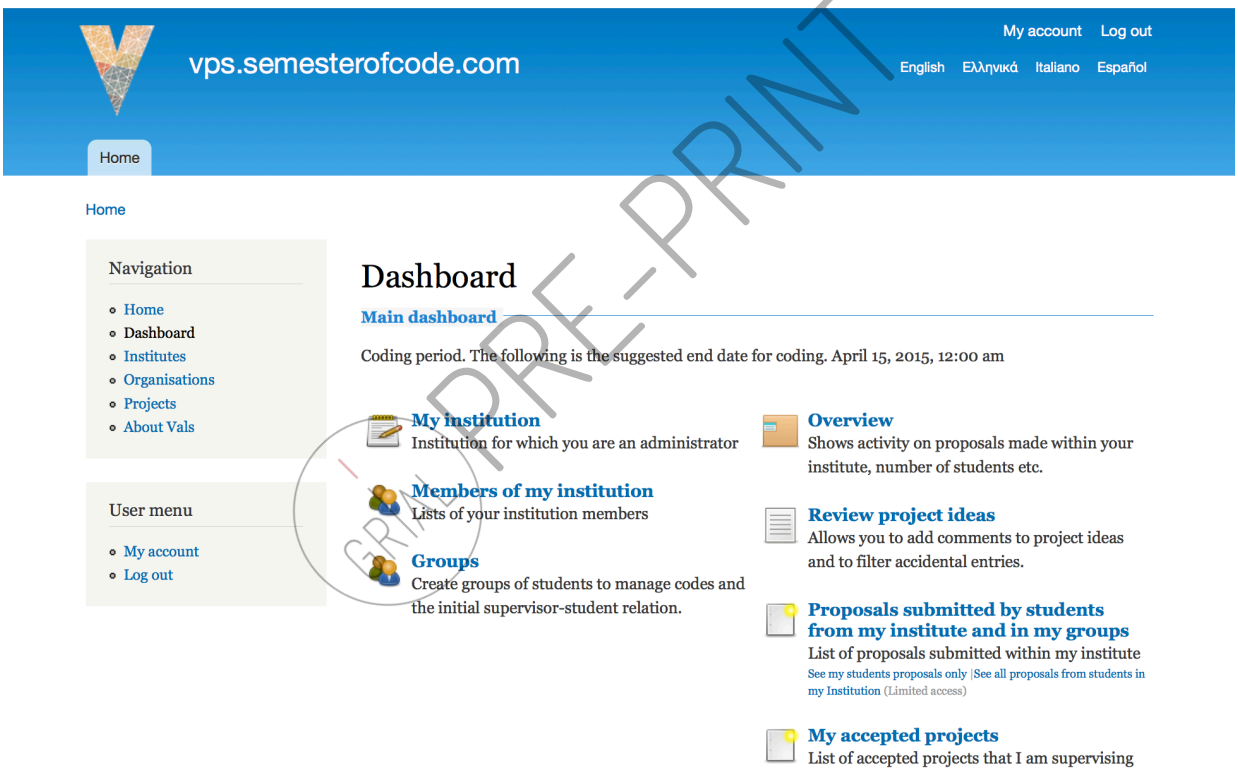

Figure 4. Virtual Placement System layout. User's dashboard view

IV. Assessing Virtual Placements

The assessment of the Virtual Placements is one of the key points to ensure the quality of the placements and the work done by the student developing the project [18]. As other authors stated "Virtual Internship activities need to be evaluated. Not only do you need to evaluate the performance of students taking part, but you also need to assess the overall process, with a view to making improvements to the approach for future Internships" [19].

Regarding this assessment of the Virtual Placements, the VALS project will establish methods to evaluate both aspects of the placements: the placement itself (including organization, help provided to student, commitment from the stakeholders involved, etc.) and the work done by the student in the placement. Following the main issues that should be addressed in both assessments are highlighted:

- *Assessment of the Virtual Placements:* This assessment is intended to evaluate the placement, its organization, development, strengths, weaknesses, etc. as well to identify the improvements that should be addressed to get better Virtual Placements. The report and assessment should be distributed between the different stakeholders that are involved in each placement:
    - The VALS partners should assess the results and outcomes of the placement, the issues they found from the beginning of the process until the end. They should evaluate which improvements should be addressed for future placements, the problems that can be a risk for the placements success, the strengths of the process, etc. All of this information will be capital to improve the experience and get better Virtual Placements.
    - The Company or Foundation should assess their experience offering this Virtual Placement in the Semester of Code regarding to the organization, communication with the Semester of Code administrators and managers, the communication with the student, the adequacy of the Virtual Placement System, the issues to improve, the features to include in the placements and Virtual Placement System, etc.
    - The Business Mentor should assess its personnel experience with the placement and the students mentoring, the communication with the Student and the Academic Supervisor, the problematic issues found in the Placements, and the ways to achieve the success that the Business Mentor have detected for the Placements (best practices, etc.).
    - The Higher Education Institution should assess the ease of the Virtual Placements adoption in its context, the complexity of bureaucracy to recognize the Virtual Placements, the issues that should be improved to enhance the process for this kind of institutions, the adaptability of the process followed by the institution to other Higher Education Institutions, etc.
    - The Academic Supervisor should assess the established process for the Virtual Placements, its personnel experience mentoring the students, the features that can improve the process, the communication with the other stakeholders involved in the placement, etc.
    - The Student should assess the development of the placement, how he or she feels the process, what skills has acquired, what things has learned, what issues are a problem for the success (and what issues are a factor for the failure, if it is necessary). This report is very important to improve the Placement from the point of view of the intern and to achieve a smooth process that will help the student to feel more comfortable with the Placements.
- *Assessment of the work done by the student in the Virtual Placement:* This assessment is intended to evaluate the practical outcomes from the Placement, to evaluate if the placement was successful in terms of the resolution of the business problem and to assess if the academic issues were achieved successful to officially recognize the placement and reward consequently the student with ECTS credits or another kind of rewards that establishes each Higher Education Institution. The report of the placement will be developed by two stakeholders:
    - The Business Mentor should assess the resolution of the problem, evaluating the technical part of the solution, as well how the student accomplished the solution provided. Also the Business mentor should assess the student's skills, what are the main issues that student has faced up during the process, the concepts that has learned the student, etc. If this report is satisfactory, the student will get the recognition of the placement from the Project, Company or Foundation that demonstrate its success. Also this report could be used by the Higher Education Institution to establish some academic rewards (like the official recognition of the placement as curricular or non-curricular practices for example).
    - The Academic Supervisor should assess the academic issues that the student has addressed during the development of the Virtual Placement and the project. This assessment should include the usage of the proper methodologies by the student, the correction of the code developed by the student or other metrics established by the Higher Education Institution that demonstrate the academic quality of the work done by the student. This report will be used by the Higher Education Institution to give the student the academic rewards proposed previously.

The VALS partners, depending the stakeholder that provides it, will collect this assessment in different formats. In

some cases will be a report filled by the stakeholder involved, in other the assessment will be obtained through personal interviews, questionnaires, etc. In any case, the assessment should provide the best information possible to the VALS partners, in order to correct, improve or enhance the different factors that allow to achieve satisfactory Virtual Placements.

V. Semester of Code Pilots

This section describes how is performed the Semester of Code pilots, how are practically organized, what are the issues, strengths and weaknesses observed in the first phase of the pilots, and also the future planned for the next pilots.

A. Description of the Semester of Code first pilot

The Semester of Code has planned two rounds for Virtual Placements, one between September 2014 to January 2015 and the other between February-June, 2015. The first pilot could be described as a beta-pilot, more restrictive and intended to research about the validity of the process designed by the VALS partners and to test how are performed the Virtual Placements in the different Educational Systems and how is adapted the workflow to each university. For the second pilot, new projects and those not solved at this first round will be included, and many other universities will be involved in order to test the system and workflow in a deeper way and with more case studies.

Regarding the first phase of the pilots (the current pilot) is now on the students' application process. There are 246 project proposals accepted from 64 companies/foundations at the present (November, 2014); this is a huge success from the point of view of the projects. There are also, at this moment, about 12 universities from 6 different European countries (Spain, United Kingdom, Cyprus, Italy, France and Serbia), and it is expected to get engaged some other universities before the deadline for students' application. Regarding the universities participant, the VALS project is in touch with at least the double amount of universities from these countries and others for the second round of pilots.

VALS partners found some problems regarding the engagement of the students, Academic Supervisors and other partners in the Semester of Code. These issues are a risk for the success of the project and the pilots. In the following subsection (Strengths and Weaknesses in the Semester of Code pilots) the issues will be described as well findings detected in the pilots.

B. Strenghts and Weaknesses in the Semester of Code pilots

During the first phase of the Semester of Code pilots, VALS partners found some strengths, weaknesses and issues that should be tracked in order to achieve the success in the pilots. Following, the main findings are described, organized by the stakeholders that are affected:

- Higher Education Institutions and Universities:
  - Administrative processes in the universities are very strict, especially regarding schedules, and are not shared by all the universities all over Europe.
  - Schedules and workload in companies are not always compatible with universities ones and students' planning.
    - This is resolved in many cases by ad hoc adaptations and making more flexible the administrative processes in the universities (it depends on each university and the people involved in).
- Academic Supervisors:
  - The engagement of the academic supervisors to participate in the Semester of Code relies in the most part in the personal relationships between the managers of the Semester of Code in each University and the professors or other faculty staff.
  - There is a very marked altruistic behavior in the people involved as Academic Supervisors in the Semester of Code, because the program does not give money for participation.
- Students:
  - They need time to include VALS activities with their own plans (short term plans are not usually compliant with the most of the students' reality).
  - The VALS benefits must include academic rewards (credits recognition for the placements, reusing the work done for their final degree works, and so on) to engage them.
  - They have fear (in many countries) of the English communication, the workload, and the effort done in the proposal definition, among other different excuses.
- Companies and Foundations:
  - They are inline with this kind of initiatives, because most of them have participated in other programs like the Google Semester of Code.
  - They expect an agile process and a flexible program that allow getting quick results and outcomes; in the same way most of them work internally in their business.

As a brief summary of the findings in the first phase of the Semester of Code pilot, could be highlighted the following ideas:

- University managers like the VALS proposal (and Semester of Code), but the University is slow in reaction to participate in this kind of initiatives and need effort and volition from the personnel to make the Semester of Code a success in their context.
- Companies and Foundations rely on VALS ideas (64 at least), but they want results immediately (which confront with the Universities reality).

- Students think that VALS and Semester of Code is an amazing opportunity, but they need time to internalize VALS new opportunities.

All of these findings are been taking into account for the first phase, but will be fully adopted for the second round (and other future rounds) in order to enhance and improve the pilots and placements, as well as the stakeholders' experience with the Semester of Code.

C. *Future: Second round of pilots*

After the first round of the pilots, the VALS core team has planned a second pilot within the European-funded extension of the project. This pilot was not planned at the begin of the project, but all the partners agreed that the division of the pilots in two phases would help to cover the possible timelines and schedule of the universities across Europe (at least would help more than only one round of pilots).

The second round is planned to begin in February 2015 and extends to July 2015. In this second pilot will be available those projects not solved in the first round, and those that want to join to the program as new proposals. This second round also is an opportunity to scale the number of students and universities involved in the Semester of Code, testing the design of the process with more case studies and will raise more insight about how can be performed the Virtual Placements in the context of international placements for Informatics students.

VI. Conclusions

After the first phase of the VALS project is time to make real the proposed approach for virtual placements and the Semester of Code initiative. This is a very important part of the project due its goal of performing real placement experiences, thus also it allows to the stakeholders getting the rewards of the win-win approach of the project.

This point of the project is also a good moment to review and assess the steps followed and to plan future actions, and even improving, correcting or to pivot certain issues and features of the designed artifacts for the project in order to achieve the final success.

The setting up of the processes, methodologies and initiatives like those described above are especially hard and need to time enough to settle in the involved stakeholders. The European and International context of the Semester of Code, the differences between the different educational system, the different ways to procedure between the Business stakeholders and Higher Education Institutions regarding schedule, timelines, agility etc. as well as other issues found in the Semester of Code pilots create a gap that needs to be solved in order to achieve of the project and the virtual placements. However, apart of these issues and findings, the Semester of Code pilots are running in several universities, with a huge adoption of the initiative from Companies and Foundations, and with a very high interest from the Academia, which is very encouraging for the partners involved in the project.

Because of the potential and the benefits of VALS, we think that the goals will be easily a reality if the project has the chance of going further of a couple of pilots and is able to engage more stakeholders in the processes, that will result in establishing a permanent flow of placements offering and application demand which. This will ensure the future of the project and its possible adoption as a real approach to perform virtual placements across Europe (and maybe the World), enhancing the curriculum and skills of Informatics students (and other areas that could fit in the processes designed) and improving the knowledge alliances between Business and Higher Education which will be reflected in the current Technological Society and their citizens.

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