Teaching precision farming and entrepreneurship for European students: Sparkle online course

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Abstract

Within the framework of the European project named “SPARKLE” an online course was created after studying educational needs on precision agriculture (PA), state of the art of technologies and a prospective study of the commercial sector. Five educational and research institutions, high-tech farms and enterprises specialized in technology transfer created the syllabus of the course and the platform contents. The course was designed to provide 30 h of student dedication, via online presentations, documents and videos for each topic. A free pilot course started in April 2020 and 385 students from Italy, Portugal, Greece & Spain enrolled. To trace performance and acquisition of competences, questionnaires were completed by students for each topic and a final overall test. Students’ opinions about the course were also registered using anonymous polls, and results evaluated, to be able to enhance the Sparkle course for subsequent editions. Students also took part in a business model competition, to solve real challenges proposed by farms, related to the use of these technologies.

Keywords: education, competences, e-learning, free course.

Introduction

According to a foresight study of the European Parliament Research Service (EPRS-STOA, 2016) the introduction and uptake of PA requires new skills to be learned. As many studies concluded, one of the factors that could contribute to the low and mixed adoption rates of PA include the lack of farm operator education (Yang et al., 2015). Adoption rates of PA technologies are even lower in Mediterranean small farms, increasing the digital gap with other areas (Loures et al., 2020). Young farmers and agricultural students need to be equipped with the right mix of both business management and technical skills to be able to put PA into work. Educational institutions have an important role to play by introducing contemporary tools, methods and solutions to students of agriculture (Värnik et al., 2017). However, current curricula of main agricultural engineering schools do not always provide such competences and knowledge. The main objective of the Erasmus+ Knowledge Alliance project named "Sustainable Precision Agriculture: Research and Knowledge for Learning how to be an agri-Entrepreneur" (SPARKLE, 2018) was the creation of an online course to cover the educational gap in precision farming competences for European students and farm technicians. The 'Sparkle consortium' is formed by the University of Firenze, University of Évora, Universidad Politécnica de Madrid, Centre for Automation and Robotics (CSIC-UPM), and a range of enterprises (AgroSAP; ValueDo, ErreQuadro, Rezos Brands, Quinta da Cholda, and Marchessi Mazzei) ,

Materials and methods

Educational needs

During the first phases of the work, surveys were created to test the opinion and trace previous PA knowledge of students at agricultural schools in Italy, Greece, Portugal and Spain, but also to farm technicians as well as selected experts on PA from academia across Europe. Quantitative polls were presented to the students of undergraduate, graduate and master levels, while personal, qualitative interviews were conducted with farmers and experts. Questions (114 items overall) ranged along a variety of competences, from agronomic, technological, environmental and managerial skills which should be taught in a course about PA.

Prospective study on patents and publications

During the research on educational needs, a foresight analysis was also conducted on more than 62000 patents and scientific papers related to PA. Entries were extracted from "PATSTAT Global 2018 Autumn Release" (a service of the European Patent Office, EPO) as well as ScienceDirect (Elsevier publisher). Documents were classified according to different criteria: type of crop ('viticulture' or 'arable crops'), cultivation steps (from planning the field to harvesting), technology (no limitation within the definition of PA), time boundaries (patents filed after 1990, papers published after 1985) and no geographical limits. Data mining techniques were applied to all entities using a proprietary software of computational linguistics, that allows the massive analysis of texts and the clustering of the extracted information into meaningful patterns and trends. Also, a specific report on the state of the art of agricultural robotics was produced, after extensive review of bibliographic resources.

Course syllabus and materials

After compiling the results from the state of the art, technological trends and educational needs, course structure and course contents were outlined by all members of the consortium using an iterative approach. The duration of the course was set to 3 ECTS (European credit transfer system), and course activities were established into three categories (online lessons, practical face to face sessions and entrepreneurial sessions) following a blended learning scheme (e-learning, plus in-person activities). Course syllabus was divided into areas, lessons and topics. Minimum materials for each sub-topic were decided (1 presentation, 1 written document, 1 quiz with at least 10 random questions per topic), plus additional materials (videos, audios, link lists, pdfs, papers and technical documentation). Over 40 experts participated in creating the course contents, while 3 editors reviewed and edited all materials (language, style, layout). Course materials were produced in English, although documentation and videos for the practical sessions were generated in local languages (Italian, Greek, Portuguese and Spanish)

Learning management system

A dedicated learning management system (LMS) platform was created using the open source software "Moodle" (version 3.10, Moodle Pty Ltd, West Perth, Australia), where all course materials and documents were uploaded. Enrolled students could access the site using a supervised registration form. Track of all student activity was recorded, including answers to quizzes filled at each topic and the final general test. Also a specific forum area was created to solve students' questions and serve as a place for interaction between teachers and course students. After completing each lesson, students were presented with links to opinion polls to rate and give feedback about each section of the course.

Results and discussion

Outcomes about educational needs using surveys and interviews, the foresight analysis and the report on the state of the art on robotics are freely available at the project web site (Sparkle, 2018). Detailed explanations are given there on the methodology for the compilation of data, the statistical and linguistical analyses, as well as the results obtained.

In this document, further details are presented about the course itself and about its results, according to enrolled participants. Course syllabus is summarised in Table 1. Contents were structured into four areas, twelve lessons and forty-four topics, covering a wide scope of subjects, from the agroecosystem, to the main PA technologies, legal, social and economic themes, and a toolkit for agricultural entrepreneurs. A collection of 'case studies' was also included within the syllabus, to draw attention to the practical application of topics. A total of 385 people enrolled the pilot course, mainly from the four organizing countries, but also including a fraction (~ 5%) from places outside Europe. This number of enrolled participants exceeded the objective initially planned by the consortium, of 30 students per country. 80% of the people enrolled were students from the universities mentioned, but a significant number of people (20%) were technicians and farmers interested in the acquisition of such competences. The final setup of the LMS platform was done by the end of March 2020 (Figure 1), the pilot

course was launched in April 2020 and lasted a variable number of months (from 3 to 5) depending on the country.

Table 1. Summary of course syllabus, with contents divided by 'area', 'lesson' and 'topics' covered for each course section. Source: SPARKLE moodle platform, 2018

Areas	Lessons	Topics
Area 1: Sustainable Precision Agriculture (SPA)		
	Lesson 1: Introduction to SPA	6
	L2: Variables and systems	4
A 2: Precision Agriculture Technologies		
	L3: Positioning systems	2
	L4: Proximal sensing	4
	L5: Remote sensing	2
	L6: Variable rate technology	4
	L7: Robotics	4
	L8: Data analysis	3
	L9: Communications	3
A 3: Social and economic aspects		
	L10: Policy and management	11
A 4: Entrepreneurship in agriculture		
	L11: Entrepreneurship in SPA	8
	L12: Toolkit for Agri- Entrepreneurs 4.0	5
Training materials (practical sessions)		

During the whole length of the course, students were offered the full collection of online materials freely available, to be studied and completed in any order. The tutoring system set up at the course forum was backed up by teachers from all universities in the consortium. However, student usage of the forum was scarce, probably since English was not their mother tongue. Due to the pandemic situation, face to face practical sessions, as well as the entrepreneurial activities had to be postponed, and finally fully converted into online sessions, without hindering student interest in them. The topics covered in these sessions ranged from the use of geographic information software (GIS), agricultural webservices and satellite imagery, to practical field sessions with farms and specialized enterprises.

For the entrepreneurial activities, students were distributed in groups for collaborative work. Farms already applying PA procedures were invited to create "a challenge" to be solved by the students. Groups worked over several weeks and presented their ideas to a national panel of experts, in the form of a video, a presentation and a canvas business model with their innovative solution. One winning team was selected in each country, and the four final groups of students were invited to present their winning ideas at the final international event of the project.

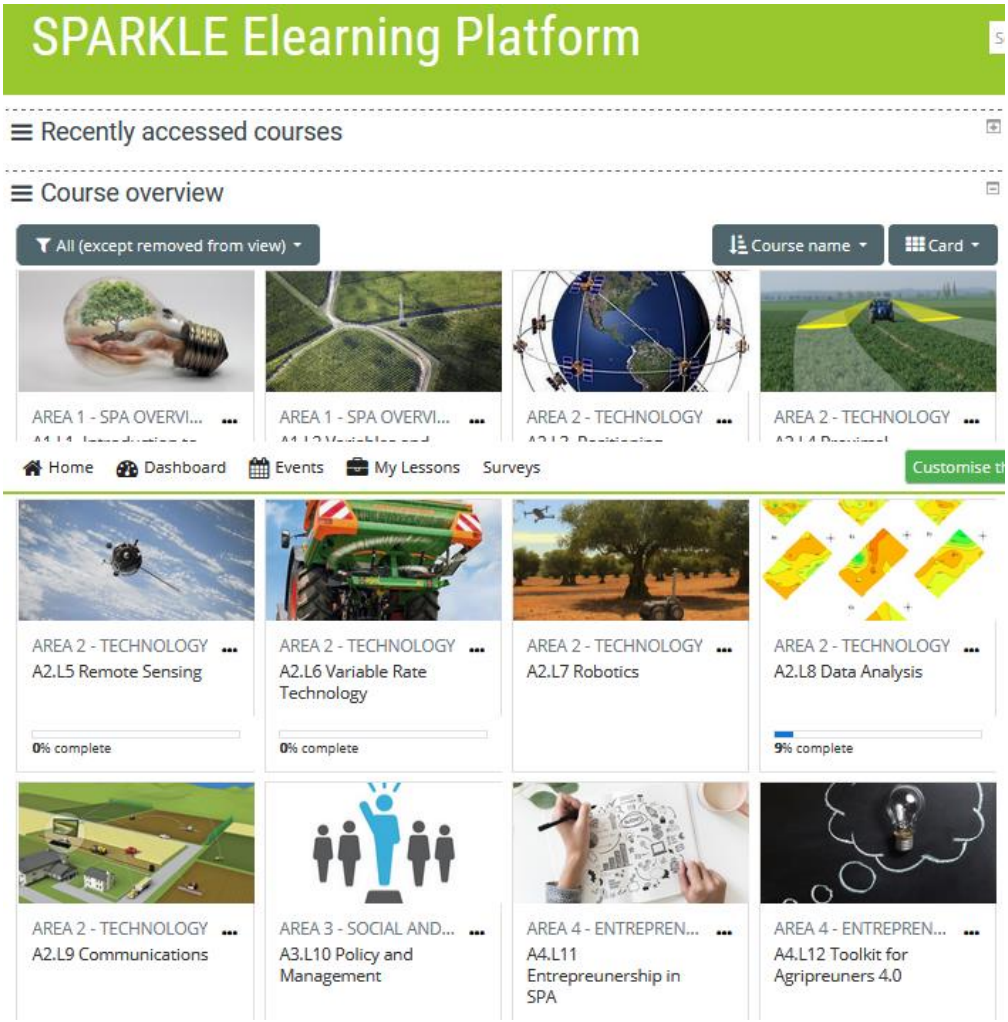

Figure 1. Overview of the initial page of the Sparkle learning management system, accessible at http://sparkle-project.eu/moodle/.

When course results were studied, figures about course completion were less optimistic, as a substantial number of students gradually opted out of the course or just failed to complete all the tests proposed in the lessons (Figure 2). This outcome is attributed to the fact that for some of them, the end of the course was coincident with their exam period at their schools, but also to the excess of online activities for students at universities due to the pandemic.

About the course student feedback, the number of surveys received after the completion of each topic was 4365, ranging from 35 for the final topics to 204 for the first topic in the syllabus. This steady drop in surveys coincided with the drop in registration rates, as a portion of students was still in the middle of the course. Most people voted “Like” or “Like very much” across all 4 questions. These 4 questions asked them to rate the following aspects from “Dislike very much” to “Like very much” on a 5-point Likert scale: 1) Contents of the lesson, 2) Structure of the lesson, 3) Total length / duration, and 4) Use of English language.

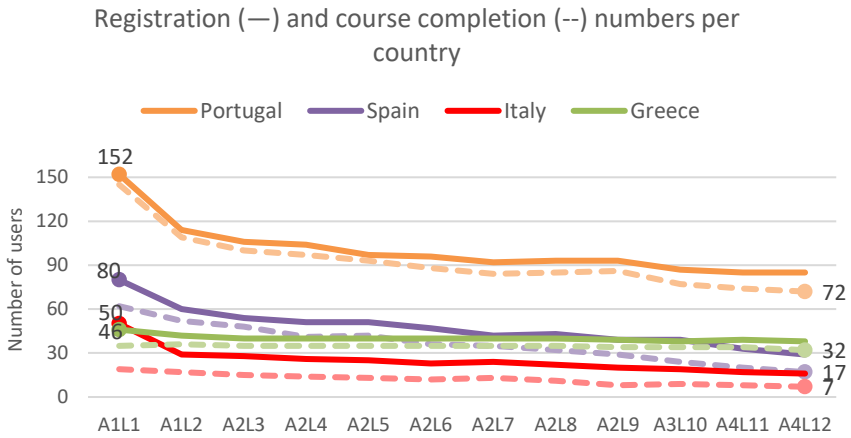

Figure 2. The number of users registered to a country group, and their completion rates. Horizontal axes indicate areas and lessons of the course, and thus relates to time.

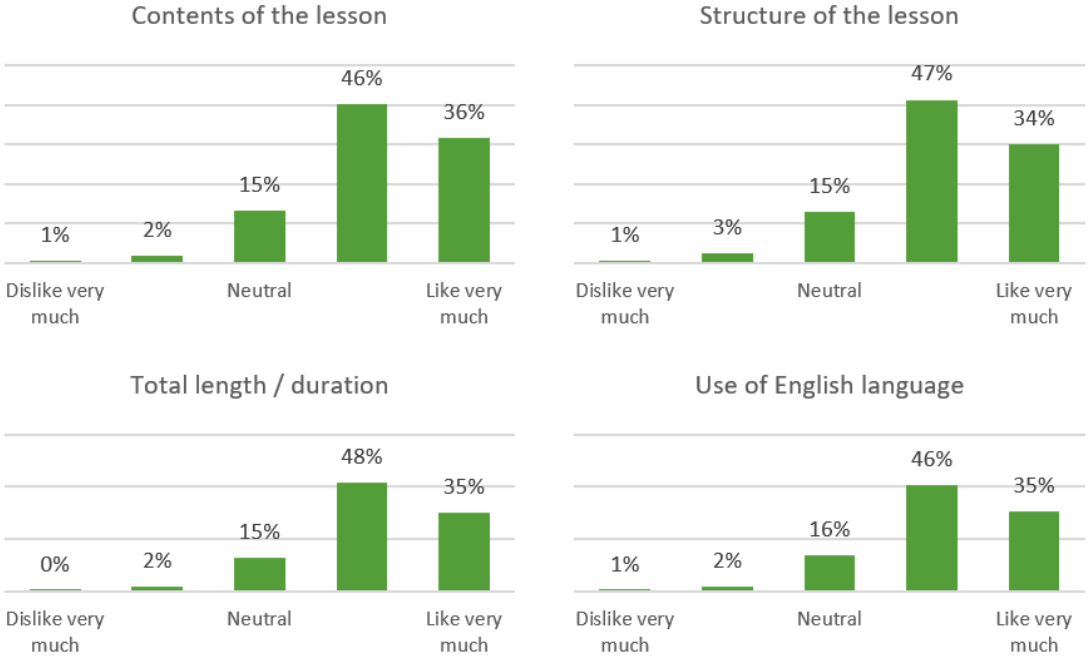

Figure 3. Students' feedback about contents, structure, length and language of the course.

The course evaluation form at the end of the final topic received 117 responses by June 1st. The majority of students (56%) voted that they somewhat agree to the statement "In general, the contents were clear to me", and that the course materials were "Helpful" or "Extremely helpful" (Figure 4). From this, it can be concluded that the contents as a whole were considered sufficient but leave room for improvement in the eyes of most of the participants. Regarding the difficulty of the pilot course, 91% voted for "Adequate". This indicates that the perceived lack of clarity did not stem from the difficulty of the lessons but suggests that improvements can be made in the delivery.

The course was designed for 3 ECTS, translating to 28 h on average. Roughly the same amount of people (Figure 5) indicated that they finished in less than 20 h as the amount of people that said they had spent more than 30 h, which means it can be said that the

duration had been estimated well at 3 ECTS. In terms of content type, the slide decks and the written materials were preferred over the videos, which can be explained by the fact that many lessons included an array of externally produced videos from either companies or youtubers to enrich their lesson materials, making them less essential in understanding the core themes.

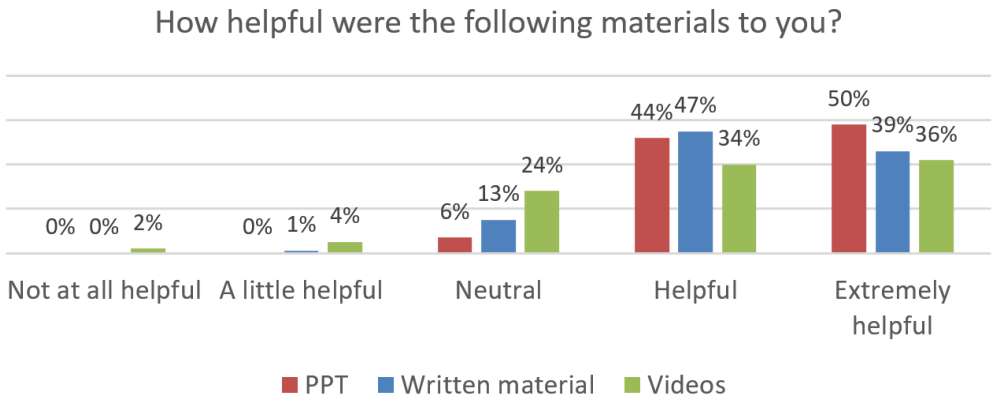

Figure 4. Students' feedback about course online materials.

Regarding the adequateness of the Moodle platform for this course, more than half (53%) voted it to be "Adequate", with another 25% voting for "Very adequate". From this it can be concluded that the Moodle platform is highly appreciated by the participants. Finally, when asked whether or not they had difficulties following the English used throughout the pilot course, the results were rather evenly distributed between "Not at all" and "A little", with only 3% indicating they found it "very" difficult to understand it.

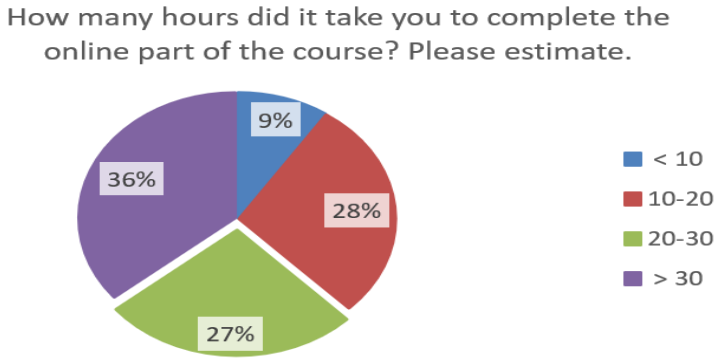

Figure 5. Perception about the time needed to complete the course.

Conclusions

Within the SPARKLE project, a full online course of 3 ECTS on precision agriculture and entrepreneurship in agriculture has been produced, trying to cover the educational needs of agricultural students and farm technicians dealing with the application of new technologies. Despite the fact that the launch of the course coincided with the pandemic lockdown, the number of participants enrolled exceeded 300. Students were overall satisfied with course contents, online materials provided, length and complexity of

themes. Online courses such as this “Sparkle course” are perceived as a good source of knowledge and competences by the students, when in-person education cannot be provided.

Acknowledgements

This project is co-funded by the Erasmus+ program of the European Union: SPARKLE is a Knowledge Alliance Project (588241-EPP-1-2017-1-IT-EPPKA2-KA)

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