



Type of the Paper *Oral*

SPARKLE e-learning course: entrepreneurship and knowledge for precision agriculture

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Abstract: Latest advances in new technologies applied to agriculture create a barrier in the job students' prospects. In the brief period, future-oriented farmers will require the presence of small and medium-sized enterprises (SMEs) capable of providing innovative solutions to agriculture. New companies should have business models providing "digital accompaniment" to the farmers, along with research institutions. At European level, students are well prepared in agronomic terms but feel uncertain about the new business models based on the effective use of new technologies for sustainable precision agriculture (SPA). SPARKLE's goal is to disseminate knowledge and innovation, connect universities, farmers and students providing students with learning opportunities, and facilitating universities to validate real answers to specific issues in the SPA application. The SPARKLE project contributes to the development of a methodological framework for future-oriented agri-preneurs, along with the development of e-learning-based education solutions to encourage the achievement of a new level of knowledge and maturity among SMEs, students and technology educators, business and innovation in agriculture. Main output of the project was the creation of the first e-learning course on SPA. Students enrolled for the pilot phase were also involved in a Business model Competition and an entrepreneurial experience in the applicant farms.

Keywords: sustainable precision agriculture, digital agricultural business models, education, agripreneurs, moodle

1. Introduction

European farm sector is facing digitalisation as many other sectors and also the learning methods and contents have to update. Talking about Sustainable Precision Agriculture (SPA) means technology, considering the environmental impact, an approach and a network of different technologies (digitalization, metadata, Internet of Things, IT, etc.) that can be adopted in agriculture [1]. SPARKLE, an acronym standing for Sustainable Precision Agriculture: Research and Knowledge for Learning how to be an agri-Entrepreneur, is a Knowledge Alliance project, co-financed under the ERASMUS+ project ended in 2020. One of the aims of SPARKLE was to bring together research, SPA farmers, and students to develop and fill the gap in the educational offer to prepare farmers and agriculture's business managers of the future. The consortium was composed of 3 different categories of partners [2]: - Agriculture Faculties (University of Florence (IT), Universidad Politecnica de Madrid (ES),

Aristotle University of Thessaloniki (GR), Universidade de Evora (PT)) - Companies providing advanced services to companies/farms (CSIC – research center on automation and robotics (SP); AgroSAP (Precision Agriculture consultancy (SP); ErreQuadro – technology foresight (IT); Valuedo – entrepreneurial education (IT)) - Farms adopting PA technologies (Quinta da Cholda (PT) – arable crops sector; Rezos Brands (GR) – fruit growing; Mazzei 1435 (IT) – viticulture). SPARKLE project built the necessary expertise in “agriprenurship” for more effective entrepreneurial education and innovative business practice through the development of an e-learning course on Sustainable precision Agriculture [3]. The course provides a minimum of thirteen hours of e-learning. This part is tested by online quizzes. After this self-directed online learning, the pilot test included 8 hours of face-to-face lessons devoted to improving business and management skills. To complete the educational package, the final four hours of the course were dedicated to case studies and practical activities in the field. The pilot phase was an important part to assess the course throughout students, academics, and farmers. Due to the Covid-19 restrictions, the training activities planned to take place as face-to-face and on-field activities were transformed mainly into virtual activities. However, this compulsory shift didn’t affect the training contents of the training. Besides, this opportunity gave students not enrolled in University partners the chance to complete their training and allow them to participate in the Business Model Competition(BMCompetition). Finally, all student group work for the delivery of the BMCompetition outputs was conducted online, as well as the coaching given by both University and other SPARKLE partners.

2. Materials and Methods

3.1. Developed Framework

In the SPARKLE project, sustainable precision agriculture professionals from academia and business have collaborated to develop and release the online e-learning course to help target groups (researchers, students and farms already adopting PA technologies) to advance their knowledge in sustainable precision agriculture anytime, anywhere and at no cost. All partners strongly contributed to the implementation of the project: the three target groups were reached with an acceptable size of samples for in-depth analysis. All SPARKLE universities contributed specifically to conduct state-of-the-art and needs survey analyses, co-design the overall structure of the training course as well as the detailed definition of the contents, preparing the training materials. All the University partners were involved in the development of the training materials according to their specific expertise and knowledge and conducted a cross-check of all training materials. The aim was to ensure quality and capacity of reaching the established learning outcomes, as well as testing the training materials in the four National pilot courses and their revision according to the feedback received during the pilot courses; moreover University assessed the design and implementation of the Business Model Competition, started with an open call for challenges for farmers and consisting in the development of the students of a revised BMC including SPA innovation (thanks to the coaching of the University partners). Furthermore, Universities provided organization and monitoring of the entrepreneurial experience, as the award for the winning students team. Therefore, the support gave by SPARKLE farms (Quinta da Cholda, Mazzei, Rezos Brands) contributed specifically to mentoring academic partners in the identification of entrepreneurial skills and competencies required by the labor market in the field of SPA, co-design with the academic partners the structure of the course (with specific attention to the entrepreneurial skills and the practical aspects to be included in the course), disseminate the training course through their networks, so as to reach also other entrepreneurs interested in the course contents, disseminate the call for farms and in some cases, participating directly in that. In fact, two partners farm Quinta da Cholda from Portugal and Mazzei from Italy actively participated in the intraprenurship experience envisaged by the project, hosting the winning students of the Business Model Competition directly within their company. This experience represented an added value of the project and the fact that some students had the opportunity to live it by knowing one of the partner companies has contributed to its excellent success, despite the difficulties for travel related to covid-19. Finally, farms coached the winning students of the BMC competition in developing their innovations. Talking about contribution of the other SPARKLE partners (Valuedo, Erre Quadro, Agrosap, CSIC) they specifically developed additional training resources for the course (e.g. Business Model canvas for SPA initiatives, research on technological foresight, research on robotics in agriculture), co-designed the course

structure, focusing specifically on the most advanced technological aspects of the course and the entrepreneurial education topic, but also, disseminated the call for farms and coaching the students winning the BMC competition in developing their innovations.

3. Results

3.1. The SPARKLE project: outputs and added value

On top of the e-learning course's main result, the SPARKLE project accomplished several other outputs that added further value to the overall initiative.

3.1.1. Generative Learning Community

Project SPARKLE was aimed to spread the idea of entrepreneurship in agriculture. The characteristic complexity of the new paradigm of digitalisation and high technology requires new approaches in terms of understanding, interpretation and organisation, in a competent application of new, appropriate and revised business models. The first clear step towards change was the experience of understanding the multiple implications and the many interrelated actors involved in the current paradigm of sustainable precision agriculture. Sparkle has grown as a generative learning community, which has focused not only on the target groups that have directly benefited from the project results but also on the community of partners themselves who have become aware of the complexity of innovation that has led to the development of a new learning process. The built network between the partners, who identify in Universities and Companies, gave life to a collective construction of knowledge and content negotiation. The actors involved in a heuristic approach discovered and shared experiences, information, knowledge, and skills that significantly enriched the project's educational objectives. The reflections on shared experiences have allowed partners to understand the high self-learning value of constructing meaning in constant development [4].

3.1.2 Open access & publication

The moodle course, freely available at this link <http://sparkle-project.eu/moodle>, is under open-access licence, and every unit has a DOI (Digital Object Identifier). The process of applying the DOI passed through a peer review revision provided by the Firenze University Press [3]

3.1.3 SPARKLE e-Learning Platform

One of the SPARKLE project's main aims is to develop and assemble the e-learning supporting materials for the SPARKLE e-Learning Platform. The SPARKLE project e-learning course is an asynchronous online course (courses where students are not required to participate in sessions simultaneously as the instructor) using a learning management [5]. The course's final prototype is an e-Learning course with the initial architecture (four areas and 14 topics) hosted on <https://sparkle-project.eu/moodle> web address. The course is divided into 4 areas and 12 lessons (Table 1). The target group of the course are university students, agri-entrepreneurs and academics. Inside the Lessons, 56 contents were developed [6].

3.1.4 Business Model Competition

Within the SPARKLE project, the aim was for students and entrepreneurs to acquire digital skills in different aspects of precision agriculture within knowledge-generating centers (universities and research centers) and to be able to implement them in the companies' business environment, seeking to bridge the gap that currently exists. This can generate an opportunity for farms to develop their business by adopting SPA technologies, allowing students to implement their knowledge through the creation of innovative businesses for farms and allowing researchers to collect information to evaluate the educational impact of the intrapreneurship experience. This competition promoted important values of entrepreneurship, the use of the SPA skills learned during the e-learning course generated in the SPARKLE project, and allowed cross-border work where to implement attractive technical solutions to a sector such as agriculture, in full process of digitisation into the future. Partner

Universities' launched a "Call for Challenges", asking farms in each country to present their needs and problems they wished to solve using precision agriculture. One challenge per country has been selected and the students, organised in groups, tried to solve it presenting, in the end, a new business model proposal. This report presents the awarded Business Models proposed by the BMC winning teams in Greece, Italy, Portugal and Spain. The challenge followed the following criteria: Originality, Innovative potential, Feasibility of the idea.

Table 1. Areas and Lessons of SPARKLE e-Learning Course.

Areas	Lesson
SPA Overview	1. Introduction To SPA 2. Variables and Systems
Technology	3. Positioning Systems 4. Proximal Sensing 5. Remote Sensing 6. Variable Rate Technology 7. Robotics 8. Data Analysis 9. Communications
Social & Economic Aspects	10. Policy & Management
Entrepreneurship in Farming	11. Entrepreneurship In SPA 12. Toolkit for Agripreuners 4.0

Table 2. Challenge proposed per country and farm applicant.

Challenge proposal	Country and Farm applicant
Adopting in an efficient way variable-dose seed drill for improving production, reducing cost and safeguarding biodiversity in the vineyard sector.	Italy – Marchesi Mazzei S.p.A.
Solve the need of a small family farm to know when exactly to harvest by monitoring the carotenoids of the cultivated Greek oregano in order to get the highest quality of essential oil, in conjunction with the weather conditions (Temperature and Humidity data).	Greece – Aetheleon
The loss of time due to large queues in front of olive oil industries when producers are waiting to deliver their product during the harvesting period	Spain – Ploou and John Deere
Account for the costs and profits of the adoption of three PA techniques: i) Auto-steering; ii) Variable Rate Technology and iii) Crop monitoring with satellite imagery and drones. The students had to introduce the increased costs for each technology and to determine the achieved profits comparing the net income before and after it.	Portugal – Quinta da Cholda

3.1.5 Entrepreneurial experience

All the entrepreneurial experience (as the award of the winning teams) was conducted online, as the farms could not host the students in their premises in the months when the entrepreneurial experience was supposed to be held. Despite these changes, the partners evaluated the reaction of both the partners and the students positively.

In each country, a group was selected as the winner. The award for the winning group members was the possibility to gain an intrapreneurship experience and explore the business idea on the farm. According to the students' feedback, the entrepreneurial experience's competencies were: problem-solving, communication and leadership, critical thinking, entrepreneurship and management. After implementing the intrapreneurship experience, each University partner developed a specific report to assess the efficacy of the entrepreneurial experience. On the one hand, farms reported positive evaluations such as having students collaborate with them, asking them to improve their proposal, further research on specific points and increasing their online visibility. On the other hand, students could experience a real farm and a business environment as well as the opportunity of testing if the BMCanvas created was effective and how to improve it.

4. Conclusions

The SPARKLE project embraces the "Farm to Fork" strategy of the European Commission [7]. In the long term, the partnership will evaluate whether to seize other opportunities to develop the project further. However, it will undertake to disseminate and exploit the results of the project through the built and existing networks in the short term. In this initiative, partners share the Knowledge Alliance's key features, such as higher education innovation and business innovation. In particular, the e-learning platform will continue to spread the SPA content even after the end of the project. The development of this training course contributes to a particular need that is, in actuality, unfixed. All project companies are involved in improving their relationship with the agricultural sector and collecting relevant information, advanced studies and strengthening more reliable networks with universities and companies. To create a new community of innovative agripreneurs, the three PA companies, already implementing PA technologies, would like to extend their network and contribute to the use of innovative technologies by other farms. SPARKLE will lead to a new approach to teaching and learning entrepreneurship at both formal and non-formal levels. Project activities promote entrepreneurship and entrepreneurial skills of higher education personnel participating in the project, making them educators of SPA and agribusiness. Besides, SPARKLE findings would be easy to multiply in other universities and companies to complete the project. Firstly, at little or no cost from 2021 onwards, partner organisations will easily enable new individuals from established target groups to attend and complete SPARKLE e-learning courses during their daily professional activities. Educational packages will already be validated in an open learning format. This multiplication scheme enables the partners to forecast attainable gains.

Author Contributions: Conceptualization, M.V., S.L., A.M, C.V., A.R., J.M.S. A.G., M.P.R. and E.K.; methodology, M.V., D.S., V.P., S.L., T.B., A.M.,S.N.,E.L.,M.P.,D.L., A.P., C.V., A.K., P.B., B.D., M.G.I., N.H., G.M., E.C.C., B.M., A.M., L.L., J.J.R., A.R., J.K., D.A., J.M.S., M.C., A.C.G., A.S., F.B., J.S., L.L.S., V.F.C., A.G., M.P.R., M.D., E.K., P.P. and D.T.; software, T.B.; validation, M.V., S.L., A.M, C.V., A.R., J.M.S. A.G., M.P.R. and E.K.; formal analysis, M.V.; generation of resources, M.V., D.S., V.P., S.L., T.B., A.M.,S.N.,E.L.,M.P.,D.L., A.P., C.V., A.K., P.B., B.D., M.G.I., N.H., G.M., E.C.C., B.M., A.M., L.L., J.J.R., A.R., J.K., D.A., J.M.S., M.C., A.C.G., A.S., F.B., J.S., L.L.S., V.F.C., A.G., M.P.R., M.D., E.K., P.P. and D.T.; writing—original draft preparation, M.V., V.P. and S.L.; writing—review and editing, V.P., S.L. and C.V.; supervision, M.V., S.L., A.M, C.V., A.R., J.M.S. A.G., M.P.R. and E.K.; project administration, M.V. and A.G.; funding acquisition, M.V., S.L., A.M, C.V., A.R., J.M.S. A.G., M.P.R. and E.K. All authors have read and agreed to the published version of the manuscript.

Funding: Project SPARKLE, as a Knowledge Alliance Project with grant agreement number 2017 - 3519 / 001 – 001, is co-funded within the framework of the Erasmus+ program of the European Union.

Acknowledgments: This paper was made thanks to project co-funded by the Erasmus+ program of the European Union. SPARKLE is a Knowledge Alliance Project (588241-EPP-1-2017-1-IT-EPPKA2-KA) The European Commission support for the production of this paper does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Conflicts of Interest: The authors declare no conflict of interest.

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