Is it essential the digitization in agriculture? Experiences in Curriculum Development for Agri-digitalization engineer at BSc level

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A B S T R A C T

The paper examines the role and tasks of agricultural digitalization education. The major challenges and possibilities of agricultural digitization are inevitable. With the help of modern technology, agriculture has great benefits. This article has been based on a qualitative review of the literature to prove why digitization is necessary for agriculture, and also created a proposal for Curriculum for agriditization at BSc level. There are five suggested subjects groups: Basics of economics, Agronomy basics, Agricultural economics and entrepreneurship, Agricultural digitization and the Differentiated professional knowledge. We also suggest subjects for the knowledge groups and also propose credits to each one. We summarize the Training and Output Requirements (TOR) for the suggested course. We think that new education programmes and new approaches to extension would be also needed to accelerate the transition to digitized agriculture.

1. Introduction

The development of information and communication technologies (ICT), the growth of database systems and digitization is a current topic nowadays: It is true in the corporate and also in the academic sphere. Automation and robots have been around for a long time, but the Internet revolutionizes the process management connected to network them. Thanks to increasing digitalization, enterprise devices and machines can connect and collaborate, implementing Industry 4.0. Devices such as sensors, RFID chips, 3D scanners, cameras, and robots generate data that the literature describes Big Data. It is a huge challenge to store, process, and interpret this data (Hermann et al., 2016; Ilie-Zudor et al., 2011). Digitization is not only an ICT development, but it is also widely used in corporate processes and also has an impact on the organization (Horváth & Szabó, 2019). The most published articles deal with digitization only from a technological point of view (Dworschak & Zasier, 2014; Hermann et al., 2016) or a theoretical point of view (Fettig et al., 2018; Dalenogare et al., 2018). The most published studies deal with digitization only from a technological point of view (Dworschak & Zasier, 2014; Hermann et al., 2016) or from a theoretical point of view (Fettig et al., 2018; Dalenogare et al., 2018). The development of digital technologies is embedded in all sectors of the economy and can contribute to improving productivity, accessing new markets, reducing costs, changing businesses, creating processes, new business opportunities, and new jobs. The impact of digitization is perhaps most significant in the mechanical engineering and electronics industries (Demeter et al., 2020; Nagy, 2018; Horváth and Szabó, 2019; Gauger et al., 2017). We often encounter digitization in agriculture, especially in the manufacturing and food industries, in various studies.

2. Agricultural and business digitization course and international history

Before planning or founding a new course, the question is which foreign higher education institutions have similar courses. The following list contains the most important foreign higher

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education institutions where agricultural digitization course takes place at a basic level, independently or combined with business training:

Cranfield University, Agricultural University of Athens, University of Natural Resources and Life Sciences (BOKU), University of Southampton, Ivey Business School, Rotterdam School of Management Erasmus University, University of Edinburgh Business School, University of Bath School of Management, University of Liverpool Lancaster University, University of London, Shobhit University.

All of the BSc-level agricultural digitization courses examined at the international level focus on applied IT or IT knowledge related to the agricultural sector. It is difficult to find training where agricultural and business digitization would occur together. Based on the above and using our information, we can say that the agricultural and business digitization course is widespread worldwide, the need for it is not questioned anywhere. In almost all the mentioned institutions, an institute or department manages the course and researches in this field. The course related to Agricultural and Business Digitization does not currently exist in the field of economics. The former course can be considered the informatics and administrative agricultural engineering, which ran in the field of agriculture but does not currently have a valid accreditation. The informatics and administrative agricultural engineering course have great popularity across the country. Several successful and middle-level colleagues with such qualifications work in the agricultural sector, but also in small and medium-sized agricultural enterprises, as well as in agricultural professions and administrations, a large number of people have such a degree or qualification. The Agricultural and Business Digitization course has a modern structure with a practical view, which meets the needs of the individual company managers of the Hungarian agrarian sector. In our opinion, the course is also needed because a so-called non-agrarian general manager, who does not know the basic processes/conditions of agricultural production, is not or only to a limited extent suitable for the performance of agricultural economic and IT tasks. The field of agricultural and business digitization can be interpreted by the agriculture (thanks in part to its former course) and the whole Hungarian agricultural economy, in addition to the strong need for professionals with such qualifications who have practical agricultural and information technology knowledge. On the one hand, this is also supported by the fact that job advertisements appear regularly, where they are looking for a specialist who understands business digitization and has agricultural knowledge too. On the other hand, they are looking for answers nowadays to issues such as ensuring food supply, increasing productivity, tracking agricultural products. Drone technology, or the application of pesticides with this technique, which can increase efficiency and reduce costs, can all be supported by digitization. Ensuring equal opportunities is particularly important for digital investments, but the return rate is quite different for large-scale agricultural enterprises and small farms. Also important that the development of agricultural digitalization is also included in the new CAP plans, so supporting this area may be a priority in the 2021-27 EU budget cycle, which is not realizable in Hungary without specialists with such knowledge. We must also highlight the Hungarian digital agricultural strategy, which can create the conditions for the necessary technical-technological modernizations, as a result of which the annual performance of domestic agriculture can increase by hundreds of billions. The fields of knowledge that represent the specific pillar of the basic education of agricultural and business digitization (about 40-45% of the available credits) are not part of the curriculum network in any other basic course which has valid accreditation in Hungary.

2.1. Agricultural and business digitization course

The main parts of the curriculum: digitization, agricultural economics knowledge supplemented with general knowledge (human, social, linguistic, etc.). The course aims to train professionals who can easily navigate on the field of digitization and can explore and solve the arising problems. Digitization is closely linked to the field of agriculture as well as economic, business, which is an important aspect nowadays in the knowledge-based information society. Graduates with a BSc degree must be able to understand the real production, operation and business model, and be able to create digitization models and recognize the digitization technique they wish to use solve the problems. It is necessary to be able to apply suitable digitization techniques in both the agricultural and business fields. Nowadays, it is almost inconceivable for anyone without this knowledge to be successful,

whether in agriculture or business. It is an important goal for professionals to understand agricultural and business processes and to be able to support them with IT and digitization tools and to be able to act as experts in these areas. This BSc-level training keeps for 7 semesters, where is the 7th semester is the so-called practical semester, which the students spend at an external (agricultural or economic) company. The required total study time is nearly 2000 contact hours and the required credit is 210.

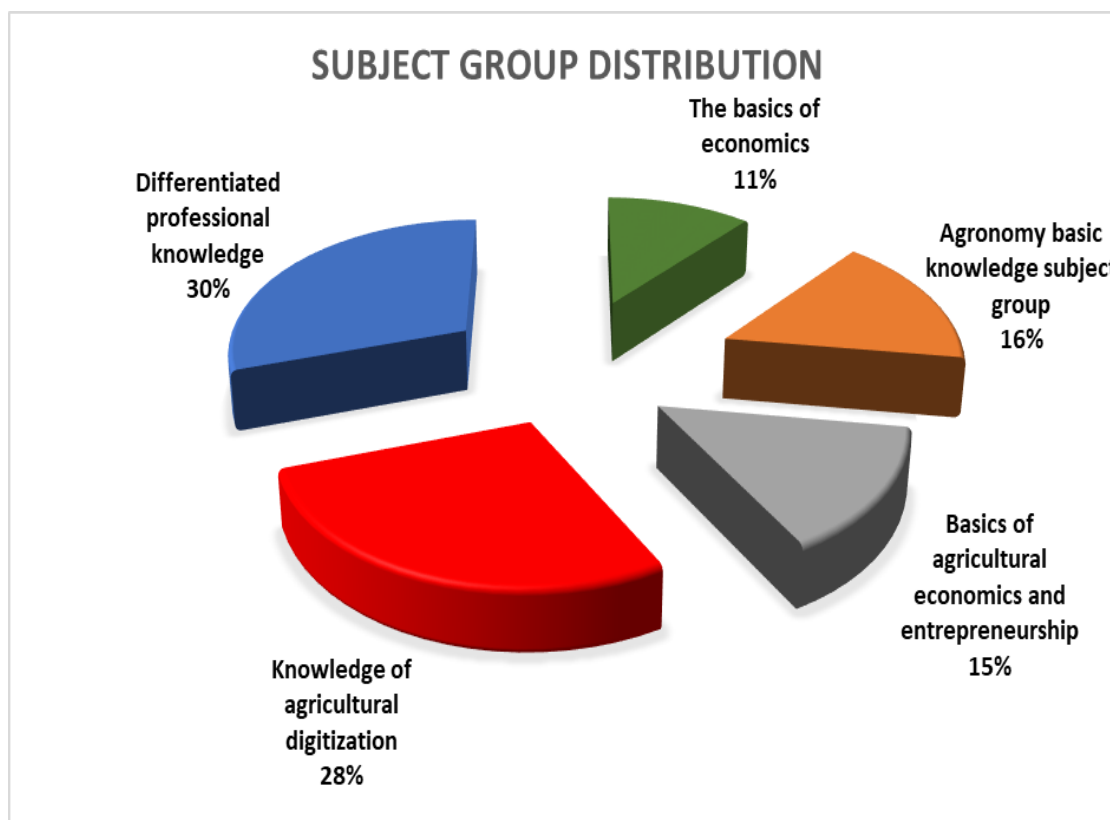The rate of subjects group can be shown in Figure 1.

Figure 1. The rate of subjects group, own source

The proposed subject groups
a. **Basic knowledge of economics:** Gives general knowledge of the field of economics (Table 1.).
b. **Agronomy basic knowledge subject group:** The characteristics of the training determine the required knowledge in the field of agriculture. These subjects are aimed at acquiring knowledge related to agriculture (Table 2.)
c. **Basics of agricultural economics and entrepreneurship subject group:** This knowledge underpins the application of digitization in agriculture and business (Table 3.).
d. **Knowledge of agricultural digitization subject group:** These objects underpin the use of digitization tools and methods used in agriculture and business. The differentiated professional knowledge subject group is based on this (Table 4.).
e. **Differentiated professional knowledge subject group:** Students can get specialized knowledge based on previously acquired basic knowledge (Table 5.).
f. **Free choice of the subject group:** Students can choose 3 subjects from courses of other faculties: The 3 faculties, which also participated in in the training, are the Faculty of Economics, Faculty of Agriculture, Food Science and Environmental Management, and the Faculty of Informatics.

According to our plans, in the initial period, the new training can start at about 20-40 people, which according to the Ministry has a serious future. With the training and agriculture ICT, practice-oriented training can start at the University of Debrecen. The possible

Table 1. Basic of Economy group subjects, hours, credits

ID	No.	Subject name	Hours	Credit
A	1	Economic mathematics	60	4
A	2	Economics	60	5
A	3	Statistics	60	5
A	4	Economic law	30	3
Basic of Economy total credit				**17**

Table 2. Agronomy basic knowledge group subjects, hours, credits

ID	No.	Subject name	Hours	Credit
B	5	Basics of agricultural production I.	45	4
B	6	Agricultural technical knowledge	60	5
B	7	Basic knowledge of horticulture	60	4
B	8	Basics of agricultural production II. (Crop production)	45	4
B	9	Basics of agricultural production III. (Animal husbandry)	45	4
B	10	Environmental management	30	3
Agronomy basic knowledge total credit				**24**

Table 3. Basics of agricultural economics and entrepreneurship knowledge group subjects, hours, credits

ID	No.	Subject name	Hours	Credit
C	11	Financial basics	60	4
C	12	Basics of accounting	60	4
C	13	Agricultural and rural economics	45	4
C	14	Agronomy management I	45	3
C	15	Agronomy management II	45	3
C	16	Business planning and analysis	45	4
Basics of agricultural economics and entrepreneurship total credit				**22**

Table 4. Knowledge of agricultural digitization group subjects, hours, credits

ID	No.	Subject name	Hours	Credit
D	17	Basic of agricultural digitization I.	60	5
D	18	Basic of agricultural digitization II.	60	5
D	19	Data processing and visualization	45	4
D	20	Agricultural database systems	45	4
D	21	Agricultural management systems	45	4
D	22	Livestock farm management systems	45	4
D	23	E-commerce and marketing	45	4
D	24	TQM in agribusiness	45	4
D	25	Supply chain management and logistics	45	4
D	26	IT project management	45	4
Knowledge of agricultural digitization total credit				**42**

Table 5. Differentiated professional knowledge group subjects, hours, credits

ID	No.	Subject name	Hours	Credit
E	27	Sector information systems	60	5
E	28	Agricultural management systems	45	4
E	29	ICT support for food safety	45	4
E	30	Basics of supply chain management	45	4

E	31	Environmental monitoring and IT background	45	**4**
E	32	Specialized sector information systems	45	**4**
E	33	ICT support for agricultural knowledge management	45	**4**
E	34	GIS and remote sensing	45	**4**
E	35	SME adaptation of integrated corporate governance systems	45	**4**
E	36	Precision agriculture	45	**4**
E	37	Management of value creation processes	45	**4**
Differentiated professional knowledge total credit				**45**

Training and Output Requirements (TOR)of the Agri-digitalization engineer

The Training and Output Requirements are an important part of a new degree because the subjects must meet this. In the following sections we summarize it:

- Learns in detail the concepts, laws, processes and contexts of economics and the micro and macro levels of organization of the economy/agriculture, as well as the terminology of related fields. He is well acquainted with agricultural economics vocabulary, the peculiarities of written and spoken language communication.

- Understands the structure, operation and cross-border of national and national relations, information and motivation factors of economic organizations, especially concerning the institutional environment. Knows the general and specific characteristics of the agricultural economy, its borders, the most important development directions, the connection of agriculture to the economic and business sphere.

- Is aware of the operation and development, administrative, accounting and financial background of the agribusiness sector. Has a comprehensive knowledge of the most important agricultural digitization tools, administration, planning, analysis and site management software used in agriculture.

- Knows the process of European integration and the policies of the European Union related to its activities. Has a comprehensive knowledge of the domestic and European Union legal regulations related to the agricultural economy.

- Knows the planning and management rules, professional and ethical norms of projects managed by agricultural enterprises and other economic organizations. Has the knowledge required to prepare project plans and EU and/or domestic funded applications individually or in groups.

- Knows and understands the system of domestic and EU administration related to the operation of the Hungarian agricultural economy, as well as the processes taking place in his field and the connections between them.

- Knows the peculiarities of the operation of rural and regional development (the role of agriculture in maintaining and developing the countryside) and the reasons for the peculiarities. Knows the relationship between human well-being and the agricultural sector, the cultural relations of the agricultural sector, its cross-cultural role and traditions. Knows the relationship between the rural economy, society and the agricultural sector, the social necessity of community development, the related environmental policy contexts.

- Is aware of land use, ecological and integrated production technologies, especially precision farming. Knows the professional and financial conditions and principles of the feasibility of innovative developments in a sustainable food economy in economic/social/ecological terms. Knows the evaluation of the financing sources required for the implementation of developments/investments and the methodology of financial return analyzes.

- Is aware of the modern, theoretically demanding mathematical-statistical, econometric and modelling methods of problem recognition, formulation and solution, information collection and processing, as well as their limitations. Knows and uses quantitative and qualitative analysis and software-supported methods of agroeconomic research. Knows the specific research methods of agricultural economics, abstraction techniques, the ways of elaborating the practical aspects of the theoretical issues, the methods of planning, measuring and analyzing the sub-areas. It has the range of knowledge required to enter a master's degree in economics.

3. Further study opportunities after completing the BSc course

Students can choose from several master's programs based on the basic course of agricultural and business digitalization. Perhaps the most recommended master's program for students graduating in this major is the Master in Supply Chain Management, which is also related to our institute. Besides, of course, students can choose from several master's programs of the Faculty of Agriculture, Food Science and Environmental Management.

Our previous students regularly participated in the applications of the Hungarian Agricultural Informatics Association's dissertation and diploma thesis with their dissertations of an agricultural informatics nature and achieved valuable places, as well as presented lectures at the annual agricultural informatics summer university and conference organized by the professional organization and our faculty. We intend to continue to encourage and assist this in the future after the launch of the new program.

During the training, an important task is to recognize and embrace the quality educational needs of students who show outstanding professional skills and interest in listening to core subjects as well as differentiated professional knowledge. Further widening the interest of students with excellent progress in departmental and institute workshops, participation in demonstration tasks, Scientific Student Associations activities, and the preparation of diploma theses. As a result of talent management, these students become eligible to pursue their PhD studies upon completion of an MSc program at a Faculty or Fellow Faculty. One important outcome of talent management can be to obtain a PhD degree. During their PhD studies, these students become involved in university BSc, education, and can pass on the approach developed during their training. Among them, the young and agricultural and business digitization teachers and researchers can be selected from among the young people.

Summary

The scope and direction of digitization in agriculture need a reaction to higher education. The main contribution of this paper is to highlight the importance of digitization and also suggest a BSc level curriculum. With the suggested BSc course the benefits of ICT can be approved in agriculture. As has been shown, data-driven innovations in agriculture have become unavoidable and a modern entrepreneur have to know about it and also try to apply it. The digital communication and massive volumes of data from the farmers and rural economies have possibilities to improve the level of production. It can be expected that the implementation of ICT in agriculture will vary depending on local capacities and strategies, but those farms that will turn into fully networked and digitized businesses will be better economic position. Without enhanced education, the digitization opportunities in agriculture might not be fully realized. It would be therefore important to communicate all opportunities and challenges related to the use of digitization in agriculture. Farmers exchanging information and data through internet support the establishment of digital agriculture.

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