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KNOWLEDGE TRANSFER FOR ECONOMIC DEVELOPMENT: ONLINE FARMER TRAINING IN VOJVODINA

Juhász Bálint

Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

László Lengyel

Branch Office of Hungarian University of Agriculture and Life Sciences, Senta, Serbia;
Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary;
Office of Agriculture Innovation "János Berényi", Senta, Serbia

Abstract. During the five-year period of the Vojvodina Economic Development Program implementation, €350 million has been invested in the target area. The aim of the present research is to review the process and achievements of farmer training and to introduce a model of successful knowledge transfer. The success of online farmer training was analyzed using statistical methods. A general model introducing a concrete practice example was developed using structural analysis and modeling. As a result of the research, we point out that improving the level of knowledge of farmers through training is a key issue in the operation of successful integration systems, in the production of crops of the right quality and quantity. Due to the fact that the design was made to be user-friendly, and requires a low-level technical equipment and IT skills, the knowledge base is equally accessible to farmers regardless of age, education and place of residence. The program expands the level of knowledge and digital competencies of the farmers, and provides useful information for further developments. The flowchart presented in the article is a suitable tool to increase the efficiency of the training today and can serve as a reference for other institutions engaged in similar activities.

Key words: territorial development, development program, investments, agriculture, knowledge transfer, online training, integration systems, production quality, production quantity.

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ПЕРЕДАЧА ЗНАНИЙ ДЛЯ ЭКОНОМИЧЕСКОГО РАЗВИТИЯ: ОНЛАЙН-ОБУЧЕНИЕ ФЕРМЕРОВ В ВОЕВОДИНЕ

Юхас Балинт

Венгерский университет сельского хозяйства и естественных наук, г. Гёдёллё, Венгрия

Ласло Ленгьель

Филиал Венгерского университета сельского хозяйства и естественных наук, г. Сента, Сербия;
Венгерский университет сельского хозяйства и естественных наук, г. Гёдёллё, Венгрия;
Центр инноваций сельского хозяйства «János Berényi», г. Сента, Сербия

Аннотация. За пятилетний период реализации Программы экономического развития Воеводины в эту область вложено € 350 млн. Целью настоящего исследования является обзор процесса и достижений в области подготовки фермеров и внедрение модели успешной передачи знаний. Успех онлайн-обучения фермеров анализировался с использованием статистических методов. С применением структурного анализа и моделирования была разработана общая модель, представляющая конкретный практический пример. В результате исследований авторы отмечают, что повышение уровня знаний фермеров за счет обучения является ключевым вопросом в работе успешных интеграционных систем при производстве культур нужного качества и количества. В связи с тем что дизайн программы был сделан удобным для пользователей и требует низкого уровня технического оснащения и навыков в области информационных технологий, база знаний в равной степени доступна для фермеров независимо от возраста, территориального распределения или образования. Программа расширяет уровень знаний и цифровых компетенций фермеров, предоставляет полезную информацию для дальнейшего развития. Блок-схема, представленная в статье, является в настоящий момент подходящим инструментом для повышения эффективности обучения и может служить ориентиром для других учреждений, занимающихся аналогичной деятельностью.

Ключевые слова: территориальное развитие, программа развития, инвестиции, сельское хозяйство, передача знаний, онлайн-обучение, интеграционные системы, качество производства, объем продукции.

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Introduction

Today, more and more measurement data and information are available in agriculture that can help you make better decisions, manage more effectively, and create sustainability. In the last decade, the agricultural sector has been completely networked with digital technologies in the areas of mechanization, soil and crop composition determination, meteorological forecasting, decision support software, and so on. It also plays a major role in training farmers, renewing and maintaining their level of knowledge. Many steps in farm management, such as the e-cadastre (e-kataszter), the digital cultivation plan, e-banking, the registration of seasonal workers, etc., have been digitized for years, so they are no strangers to the digital world and this type of communication.

The Vojvodina Economic Development Program has been now successfully implemented in Vojvodina for five years since the beginning of 2016. Based on the Regional and Economic Development Strategy of the Alliance of Vojvodina Hungarians, developed with the support of the Hungarian government, under the maintenance of the Prosperitati Foundation, an investment of around €350 million was made in the target area, with more than 14,000 projects implemented. The program is the largest foreign economic development program in the Carpathian Basin, a pioneer among similar initiatives. In addition to supporting investments and developments, it also strengthens the Hungarian community in Vojvodina by transferring knowledge. The Prosperitati Foundation offers a new unique opportunity in the field of training for agricultural society in the Carpathian Basin. In order to support the integration processes, the Prosperitati Foundation provides an e-learning service with the involvement of integrators participating in the Vojvodina Economic Development Program, and operates an online farmer training course developed by the Pro Scientia Naturae Foundation in Senta.

The concept of the online learning environment and its features are discussed by many researchers, and can be summarized as follows:

– learning is done using a device that can connect to the Internet;

– the essential element is distance: that is, neither the learning process nor its achievement is time- and place-based;

– supports individual learning pathways and conditions, i.e. builds heavily on self-directed learning and self-regulatory learning;

– the teacher or the tutor is present in the development of the learning environment and in the support of learning;

– can rarely be completely independent of the circumstances of offline learning [Papp-Danka, 2014].

"The technological development of the globalized world is creating fast changes in this area; due to IT innovations the actors of the educational system have to face new challenges" [Balázs, 2017]. E-learning is a form of training available on a computer network, which organizes the teaching-learning process with efficient, optimal knowledge transfer and learning methods, organizing both the curriculum and student resources, as well as tutor-student communication and interactive computer training software into a unified framework which makes it accessible to the student [Forgó, 2005]. It is also clear from this definition that e-learning is not

just a tool but a complex form of training / education that is multidisciplinary and includes the technicalities of the platform and other complementary content (videos, online tests, forums, forms, etc.) preparation and customization, joint preparation with lecturers / professionals, recording and processing of content, announcement and administration of training [Námesztovszki, 2020].

An important element of success in an online training system is how well users accept the new system and how receptive they will be to complete online trainings [Ouadahi, 2008]. However, beyond the applicable knowledge, we must not forget one of the potential disadvantages of online interfaces and in-service training: without physical presence, only through the screens of computers or mobile devices, teachers are less able to motivate students for both learning and participation. Therefore, it is extremely important to recognize learning theory and educational organization approaches that can be adaptive to online continuing education [Csedő et al., 2014].

There are different levels of e-learning:

1. Spontaneous level. Uploading educational content / videos to a popular site / platform. This level provides an opportunity to contact the lecturers, however, the feedback from the students is very poor and practically exhausted in tracking the number of views / openings.

2. Systematization of content. Uploading and systematizing educational content / videos, as well as supplementing them with various content (forums, tests, forms). Here you can observe a more intensive monitoring of students, depending on the completed tests and forms, as well as the forum activity.

3. Planned activity. Almost the same as the second level, but students' activities are planned in advance and branching structures may appear, depending on the learner's answers / choices. Today, MOOC-type courses are the most popular for organizing educational content [Námesztovszki, 2020].

Material and methods

First, in 2017, the need for the development of a training program that promotes more efficient use of economic development support, and then more efficient management emerged. In order to develop such an effective system, it is necessary to measure the digital literacy of the business community, to precisely define the target group and its receptivity to the various methodological solutions. For this purpose, with the support of the Ministry of Foreign Affairs and Trade, the Digital Welfare Program and the Hungarian National Chamber of Commerce, the Discovery R&D Center prepared a study called Carpathian Agri (Kárpát Agri). The Department of Carpathian Basin Cooperation of the Ministry of Agriculture and the associations of agricultural organizations operating in each region provided significant assistance in carrying out the research.

From the completed questionnaires, the conditions necessary for the proper education of the exact target group were determined with the help of the Kárpát Agri project, as well as the methodology by which the knowledge material can be delivered to all relevant users in time and in the same quality. Once the target group, its readiness and sensitivity became clear, an examination of the Prosperitati Foundation's integrator system began. Comprehensive development of economic environment is inconceivable without medium and large economic entities. With regard to agricultural developments, these entities are, by definition, agricultural processors. Their access to the market creates a serious demand for raw materials (primary agricultural products, crop), which means significant purchase potential for small family farms.

The supplier-partner relationship is particularly important both for the producer and the processor. The economic development program therefore aimed to develop integration systems. In addition to providing a secure purchasing market for producers and providing the right quantity and quality of goods to the processor, the integration system includes other important elements:

– variety definition (in order to achieve the right quality of crop, the integrator may prescribe which plant varieties are acceptable to him);

– providing production inputs (facilitates the start of the production year for the farmer and increases the security of processing);

– providing professional advice (increasing the level of knowledge of farmers contributes to the production of better quality crops);

– other services of mutual interest.

In building the integrator system, the next step in the program was to support small family farms, that is, to develop support to implement the developments that prepare them for successful cooperation with the integrator. By grouping processing capacities, five different integrations were defined: grains, vegetables, fruits, honey, and pigs.

One of the preconditions for real successful participation in the integration system is the availability of the appropriate agricultural machinery (this was helped by the calls for proposals), while the other precondition is the availability of the appropriate

professional knowledge. In successful cooperation, it is essential to produce the right quantity and quality of crop. Improving the level of knowledge of farmers through training is a key issue in the operation of successful integration systems. As Table 1 and 2 show, a very large number of more than 3,000 farmers (who also applied for development) participate in the integration system. Under such circumstances, the implementation of classroom education faces many difficulties. An obvious and effective alternative is to organize online training.

An important aspect in the examination of the integrator system was the economic positions of the integrators, their development opportunities and goals, as well as the obligations undertaken in the tender. In addition, an important aspect was the circle of suppliers (small family farms) general preparedness. During the preparation of the program, topics related to the activities of the integrator, which are very important to the program, were identified in a personal inquiry. After gathering the needs and experiences of the integrator, the obtained information was processed into a unified structure and the training theme consisting of 23 modules was created. This topic has been sent for processing by professionals who are familiar with the Vojvodina region and provide practice-oriented, useful and up-to-date information to those interested.

Important elements in the preparation of online education, which were also covered by the program that is the subject of the present research: selection of an appropriate educational platform; preparation

Table 1

Integrators and their projects participating in the integration system

#	Applicant's name	Total cost of the project (RSD)	Awarded subsidies (RSD)	Awarded subsidies (HUF)	Subject of the tender
1	**Telek Paprika Kft.**	508,205,816.00	225,345,076.00	608,431,705.00	Expansion of the capacity of the plant for processing leafy herbs and paprika
2	**Gebi Kft.**	1,116,000,000.00	502,200,000.00	1,355,940,000.00	Construction of a sunflower processing capacity of 55,000 t / year and a storage capacity of 51,312 t + 840 t
3	**Geneza Kft.**	348,803,078.00	146,497,293.00	395,542,691.00	Construction of 2342 m2 of filtration and 19000 m2 of storage capacity for organic and spice processing
4	**Tisacoop Kft.**	348,720,415.90	156,924,187.00	423,695,305.00	Establishment and operation of honey integration in Vojvodina
5	**Kontakt Kft.**	242,874,513.00	109,293,531.00	295,092,534.00	Mill development: construction of 800t processing and storage capacity
6	**Andex Kft.**	1,116,000,000.00	502,200,000.00	1,355,940,000.00	Construction of fruit and vegetable processing, distillation capacity and 7150 t capacity cold store
7	**Aretol Ltd.**	983,246,169.70	442,460,776.37	1,194,644,096.00	Increasing vegetable processing and cold store capacity
8	**Császárkert kft.**	321,157,706.00	144,520,967.50	390,206,612.00	Establishment of a unified plant area for the production of vegetable seedlings, packaging, processing and storage of vegetables
9	**Seb-Agrar Kft.**	167,020,610.52	75,159,274.74	202,930,042.00	Development of storage and processing capacity for oilseed rape processing
10	**Hollo Company Kft.**	491,800,588.00	221,310,265.00	597,537,715.00	Pig integration and feed mixer construction

Note. Source: [Prosperitati Alapítvány, 2019].

Table 2

Projects of farmers participating in the integration system

Type of integration	Approved project	Awarded subsidy (RSD)	Total cost of the project (RSD)
Grains	2708	3,354,766,099.02	5,230,010,336.83
Honey	124	101,337,464.61	135,892,995.94
Pigs	64	81,214,138.53	124,051,422.04
Fruits	84	103,380,053.90	149,986,847.40
Vegetables	241	327,326,687.50	500,121,987.54

Note. Source: [Prosperitati Alapítvány, 2019].

of digital curriculum; availability of digital devices; creation of digital curriculum schedules; development of examination forms [Proháczik, 2020].

The online platform has been chosen as the training interface, which is also a frequently used and easily adaptable, easy-to-use international system. After selecting and preparing the system and a short helping material, agricultural specialists who developed the knowledge that constituted the main element of the online training system, were involved. This was followed by the application of their written and video material to the online interface. The finished material is thus available to users in the same quality, at any time, without being tied to space. It gives the editors a useful picture of the level of knowledge, interests and thinking of farmers, which can be a very important starting point for more efficient development of further support programs.

Results

Prior to the development of the training program, a digital study of the literacy of those working in agriculture was assessed in the framework of a Carpathian Basin-level research (Kárpát Agri) and how the agricultural society can be categorized in terms of the use of digital resources. The main target group of the research was the farmers living in the Carpathian Basin, as well as the entities who are related to agricultural production in some way. The survey focused on three groups of questions built on demographic issues, management issues, issues concerning digital maturity. Due to the modular design of the questionnaire, the questions, concerning management data were filled in only by agricultural producers and employees.

The territorial delimitation of the query is limited to seven neighboring countries of Hungary, especially to the regions inhabited by Hungarians: Austria, Croatia, Romania (Transylvania), Serbia (Vojvodina), Slovakia (Highlands), Slovenia and Ukraine (Transcarpathia) (Fig. 1). The number of raw database items in the research is 795, and the number of items in the cleaned database is 781 queries. With regard to agro-IT solutions, it should be emphasized that four distinct segments can be formed:

a) *those who do not have the IT solution in question and do not wish to use it:* they cannot be considered as potential market users in the short and medium term;

b) *those who have the given IT tool but do not use it:* in-depth research is needed in this area as to what causes the equipment to be underused;

c) *who aquired and use the specific agri-IT tool:* potential users, but in their case, they can enter the market as a competition or as a new product and service innovation;

d) *who do not have the specific agri-IT tool but would like to use it:* they are the most valuable market segment.

In 2008, Oudahi conducted a survey among employees on what factors determine the acceptance

Fig. 1. Proportion of respondents by country

Note. Source: [Kárpát Agri, Discovery R&D Center, 2018].

or rejection of new IT solutions in their case. Farmers' attitudes, acceptance of the new learning methods and application of IT solutions are the key issues in the present research too. When comparing the problem areas and digitalization as a solution, two main segments are worth mentioning: 1) those who say that the topic is not a problem and that digitization would not help; 2) those who say that the topic is a problem and digitization would help in part or to a large extent.

Regarding the way of obtaining information, it can be stated that the use of the printed press and tablets does not show any outstanding value in any age group. Radio and television are still showing an extremely high level of acceptance, desktop computers and smartphones are also considered significant. 82% of those over the age of 56 use radio and television daily to obtain information, while 59% of those aged 20–25 also use it. It can be considered an age-old trend that these information carriers show a decrease (Fig. 2). The opposite trend can be observed for desktop computers and smartphones, where it can be clearly seen that younger age groups are increasingly preferring these two tools. Interestingly, personal professional contact, although not the most used source of information, shows the age trend: while among those over the age of 56, only 10% use this source of information on a daily basis, and 27% of those aged 20–25. A similar age trend can be observed for websites and online communities, and this is increasingly seen as a primary source of information for younger people. Among those over the age of 56, the perception of online communities shows the largest variance (Fig. 3) [Kárpát Agri, Discovery R&D Center, 2018].

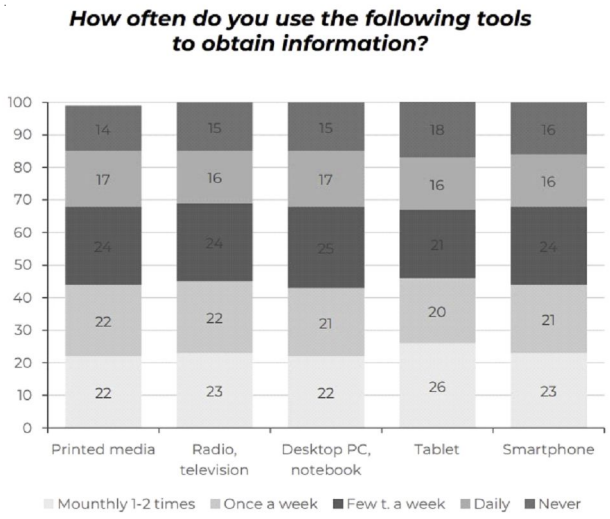

Fig. 2. Frequency of use of IT tools among farmers

Note. Source: [Kárpát Agri, Discovery R&D Center, 2018].

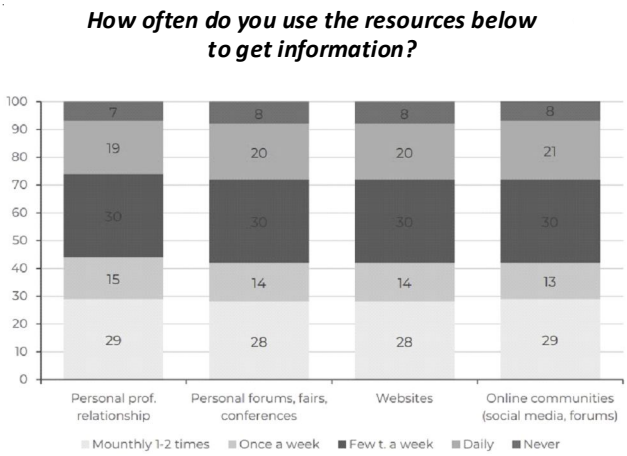

Fig. 3. Frequency of use of tools to obtain information by farmers

Note. Source: [Kárpát Agri, Discovery R&D Center, 2018].

The aim was to create a training interface and material that can be used by all beneficiaries without exception. The survey shows exactly to whom, in what way and by what means we can most effectively deliver knowledge and new information. A simple example of how digital technology is becoming an everyday thing is mobile communication, a modestly sized mobile phone, which has a significant impact on many areas of life and basic types of human activity [Benedek, 2007]. A smartphone and average mobile internet access are enough to use the online training system. Research shows that farmers, regardless of age, education and place of residence, have the necessary minimum technical knowledge and equipment.

As a result of the examination of the integration system and personal consultations, the necessary competencies have been identified, which are essential for the application of good production, practices and the implementation of agricultural production that adapts to higher quality requirements. Based on this, the topics of the professional modules were selected by experts in practical consulting, based on the questions most often asked by producers, where the most professional help should be provided, what are the current and expected problems and challenges in our area, and what was the expectation of the integrator company related to the topic and the training module. The modules that form the basis of online host training are:

1. Precision farming.
2. Food safety.
3. Theoretical knowledge of beekeeping.
4. Practical knowledge of beekeeping.
5. Follow-up in the food vertical.
6. Introduction to soil power management.
7. Soil power management in practice.
8. Irrigation.
9. Plant development and plant protection.
10. Plant protection in the field.
11. Horticultural plant protection.
12. Genetics of field crops.
13. Genetic background of vegetable production.
14. Vegetable growing in practice.
15. Growing sweet peppers for fresh use.
16. Growing sweet peppers (spice) for grounding.
17. Fruit growing.
18. Frowing of medicinal plants.
19. The practice of agricultural mechanization I.
20. The practice of agricultural mechanization II.
21. Innovative technologies in agricultural sectors.
22. Management knowledge.
23. Marketing knowledge.

EasyGenerator, which is a simple, easy-to-use, cloud-based and unique e-learning mechanism, was chosen as a platform for online learning. It has an interactive test system that allows you to test new types of measurement and evaluation in addition to traditional testing methods. It is used by the world's leading companies, such as Danone, Walmart or Electrolux. In its reporting system, statements and reports can be made about the students' study results, their knowledge and its strengths. The software is also suitable for publishing the completed course on many devices (such as mobile devices) and systems. Users can access the content through the Prosperitati Foundation's PIT application system, which directs the user to a Moodle e-learning system that records the most important data of the entrants and guides them to the appropriate curriculum. This interface is designed to be as simple as possible so that novice users can easily access it from a mobile phone. By searching the Moodle interface, the system directs you to the EasyGenerator interface, which manages posted videos, e-books, practice assignments and final exam questions. Navigating in EasyGenerator is made easy with guides and aids in Hungarian at every step.

The training material related to the modules was prepared by 13 Hungarian and 13 Vojvodina specialists, most of them from the Hungarian or Vojvodina institution of Szent István University, but some from the Hungarian Academy of Sciences, the University of Szeged, and some independent consulting companies. The lecturers first prepared the curriculum in writing, for which the editor wrote a short introductory thought of a few seconds. The short films were recorded in a classroom in front of a white wall, in such a way that the highlighted concepts, figures, pictures, etc., could be visualized later in addition to the performer. The lecture for one module is approx. 15 minutes long and a module has an average of four smaller logic units.

The content of the lectures recorded on film was also published in an e-book, which is more detailed than the film instructional material. Following the recording, the film material underwent editing, professional and linguistic verification, and then the material that has been declared final by the editors was returned to the presenter for approval. The e-book is an edited, linguistically and professionally proofread, uniformly structured written material that carries the image elements of the program, it can be

viewed from a mobile phone and a computer, and can also be downloaded and printed. The exercises that deepen the knowledge were given by the lecturers themselves, which was structured in accordance with the possibilities of EasyGenerator. After the preparation of the complete material, the final exam questions were defined jointly by the lecturer and the editor, and gave a comprehensive picture of the degree of knowledge acquired at the end of each module.

A 20–30 second video was recorded separately for each module, summarizing the topic, introducing the teacher, requirements, and so on. The video is similar to a visual table of contents, a summary. Due to system unification, all introductory videos were reported by the same person. Each module consists of four submodules based on 15–20 minute videos and a series of evaluation questions. The advantage of this is that you do not have to look through the 60-minute curriculum at once, but the student can move step by step through topics. At the end of the module, a series of final questions were placed. A submodule consists of 1 video of 15–20 minutes. Each video contains at least 20–30% of the crop or non-studio footage. In each video, 2–4 figures, graphs and illustrations were placed, which can later be used as an exam task. Each video (submodule) has a set of evaluation questions of about 10 questions. The submodule also includes a downloadable PDF file in which the student can read what they heard in the video or revisit the figures (Fig. 4).

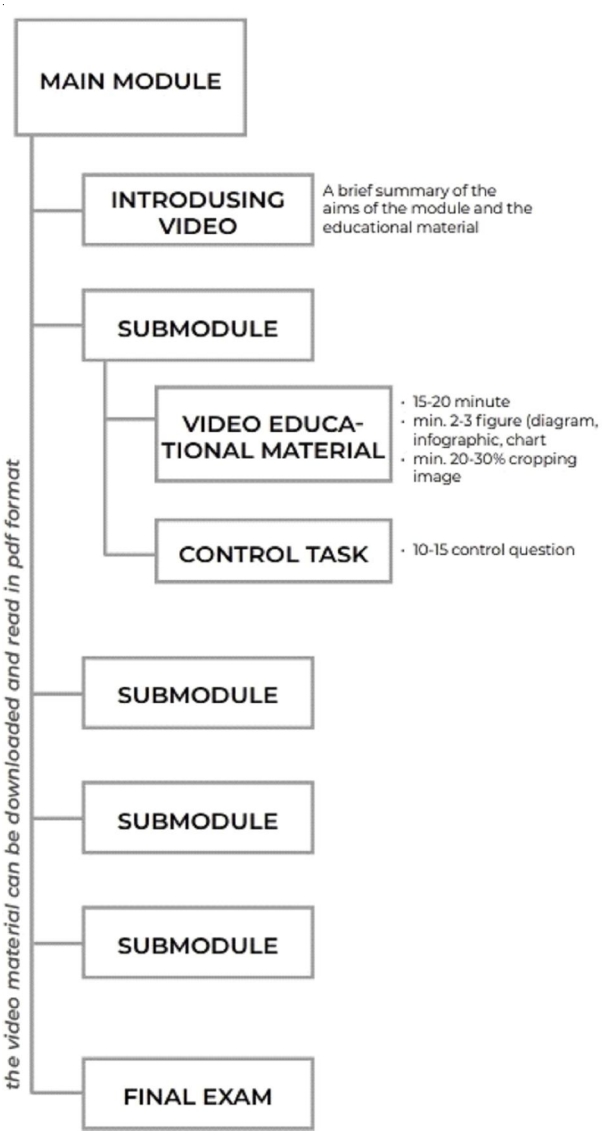

Fig. 4. Structural mapping of the online modules

Note. Compiled by authors.

The following types of questions are available during the exam:

1. True / False. A statement must be made to be true or false.

2. Multiple choice (answers a, b, c, d). A statement can be associated with four answers, from which it must be decided which is true.

3. Image-specific response selection. You must tell which image is correct for an image or figure.

4. Complete. Parts of a text are left blank and are filled in by the student.

5. Add text based on answers provided. Certain items in a text that the student can select from a drop-down menu have been omitted.

6. Collapse. Sentence parts can be connected to each other.

7. Arrange. A text / sentence must be arranged in a logical order

8. "Hot spots". Certain elements must be marked on an image or map.

Going through the program, the user can immediately see the success of the completion, in case of an unsuccessful attempt, he can resume the training, but he can also review the films or the written material several times as required. The completion of the course (module) is registered by EasyGenerator in such a way that we can track almost all attempts, clicks, mistakes and successes of the user, so we can get an idea of which are the most popular learning materials, where are the most common mistakes and where they may not understand the explanations.

A total of 3,160 farmers were able to use the online farmer training program, 703 of whom completed at least one module, and 53 farmers successfully completed all courses (see Fig. 5).

Based on the interest of the users, in order to make the acquired knowledge as widely applicable and usable as possible, the training has been accredited in accordance with Serbian legal requirements. The accredited courses cover several modules and are accepted in the following structure:

1. State-recognized approved training – Field and horticultural plant protection (3 modules).

2. Approved trainings:

a) Theory and practice of beekeeping (2 modules);

b) Soil and water management (3 modules);

c) Agricultural mechanization practice and precision agriculture (3 modules);

d) Agricultural crop production (7 modules).

In the first cycle, 383 farmers from 23 villages of Vojvodina applied for the accredited training. The most massive applications were from the villages along Bácska and the Tisza, but the farmers of the settlements of Banat also joined the training in large numbers. Almost all ages were represented, with the youngest participant being 19 years old and the oldest being 83 years old.

A total of 383 farmers (students) took part in the training, completing 883 trainings, while 299 students successfully entered and completed 676 trainings. Based on this, 227 participants obtained state-recognized official certificates and in addition, another 449 certificates will be awarded to the participants of the other four training programs. The efficiency recorded in the first training cycle is 76.55% (see Table 3).

Conclusions

The economic development program supervised and carried out by the Prosperitati Foundation contributes not only to the support of investments and developments, but also to the development and prosperity of the Hungarian community in Vojvodina by creating a knowledge base and exploring the potential of knowledge transfer.

The program offers a new opportunity for the local society in the field of trainings, and represents a unique opportunity in the Carpathian Basin.

Due to the fact that the design was made to be user-friendly, and requires a low-level technical equipment and IT skills, the knowledge base is equally accessible to farmers regardless of age, education and place of residence.

The program simultaneously expands the level of knowledge and digital competencies of the farmers, and provides useful information for further developments.

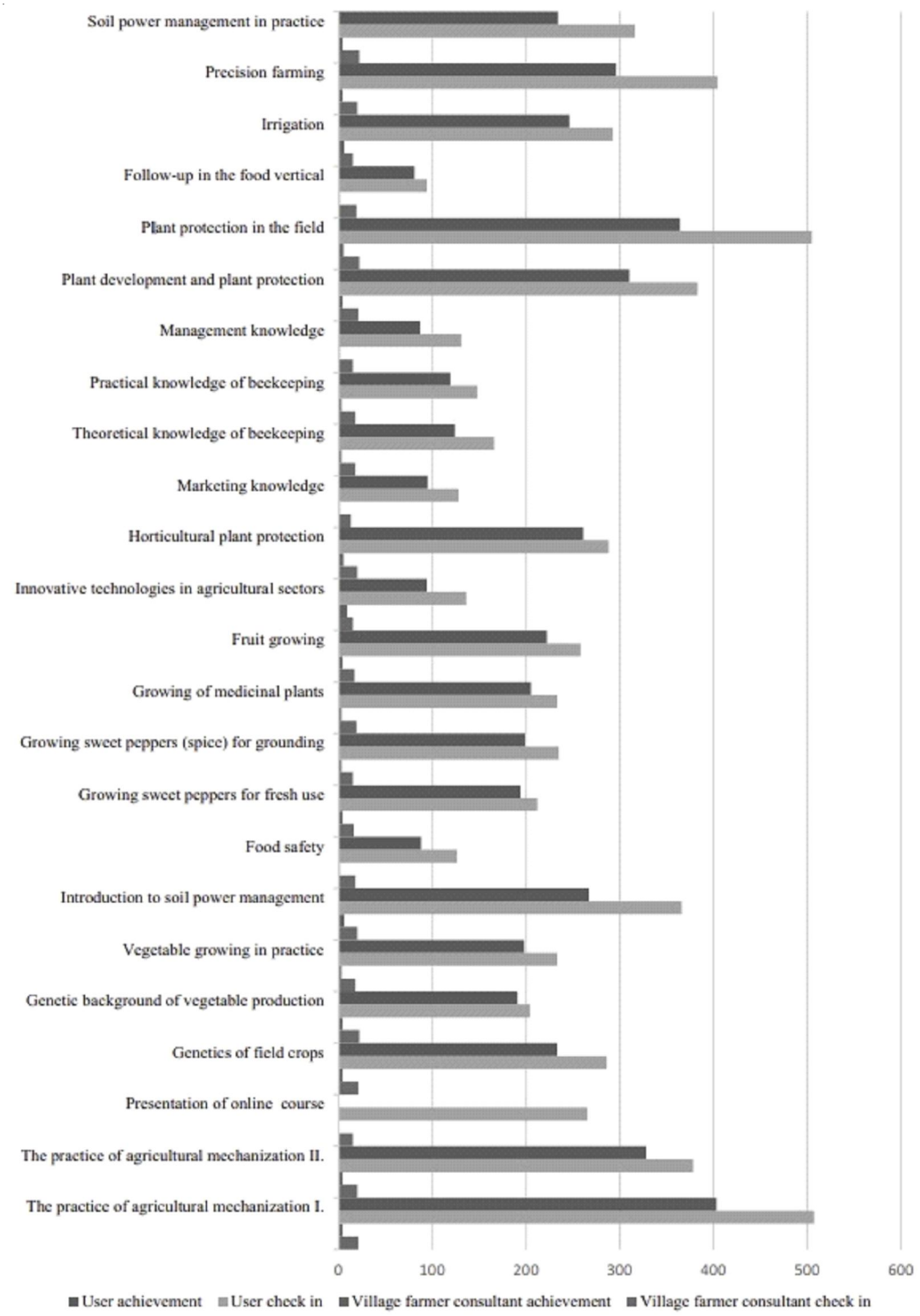

Fig. 5. Number of farmers who completed the training per module

Note. Compiled by authors.

Table 3

Participants in accredited training

Accredited training	Number of applicants	Number of successful completion
Field and horticultural plant protection	269	227
Agricultural mechanization practice and precision agriculture	205	152
Agricultural crop production	204	135
Theory and practice of beekeeping	49	37
Soil and water management	156	125

Note. Source: [Pro Scientia Naturae Alapítvány, 2020].

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Information About the Authors

Juhász Bálint, PhD Student, Hungarian University of Agriculture and Life Sciences, Páter Károly St, 1, H-2100 Gödöllő, Hungary, ifj.juhasz.balint@gmail.com, https://orcid.org/0000-0002-9602-7632

László Lengyel, Doctor of Animal Sciences, Leader, Branch Office of Hungarian University of Agriculture and Life Sciences, Senta, Serbia; Professor, Hungarian University of Agriculture and Life Sciences, Páter Károly St, 1, H-2100 Gödöllő, Hungary; Leader, Office of Agriculture Innovation "János Berényi", Poštanska St, 18, SRB-24400 Senta, Serbia, lengyelmail@gmail.com, https://orcid.org/0000-0001-8915-8143

Информация об авторах

Юхас Балинт, аспирант, Венгерский университет сельского хозяйства и естественных наук, ул. Патера Каройи, 1, H-2100 г. Гёдёллё, Венгрия, ifj.juhasz.balint@gmail.com, https://orcid.org/0000-0002-9602-7632

Ласло Ленгьель, доктор биологических наук (зоология), руководитель, Филиал Венгерского университета сельского хозяйства и естественных наук, г. Сента, Сербия; профессор, Венгерский университет сельского хозяйства и естественных наук, ул. Патера Каройи, 1 H-2100 г. Гёдёллё, Венгрия; руководитель, Центр инноваций сельского хозяйства «János Berényi», ул. Поштанска, 18, SRB-24400 г. Сента, Сербия, lengyelmail@gmail.com, https://orcid.org/0000-0001-8915-8143