Agriteach 4.0

Connecting VET teachers to Agriculture 4.0

IO2 "Training needs for the Teachers for preparing students for Agriculture 4.0 – National Survey in Republic of Macedonia"

SITUATION Analysis

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It was coordinated and compiled by the project management team from FACE, in collaboration with AgFutura and experts from all partnering organizations.

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Abbreviations:

AEC	Agency for Electronic Communications
AKIS	Agriculture Knowledge and Information System
BDE	Bureau for Development of Education
CAP	Common Agricultural Policy
DAS	Digital Agricultural Strategy
ERP	Enterprise Resource Planning
EU	European Union
GIS	Geographic Information System
GPS	Global Positioning System
ICT	Information and Communication Technology
ILO	International Labour Organization
ITU	International Telecom Unit
MAFWE	Ministry for Agriculture Forestry and Water Economy
MES	Ministry of Education and Science
MIOA	Ministry for Information Society and Administration
MTC	Ministry of Transport and Communications
OER	Open Educational Resources
UKIM	Ss. Cyril and Methodius University in Skopje
UNDP	United Nations Development Programme
VET	Vocational Educational Training
WBCs	Western Balkan Countries

Contents

1 INTRODUCTION

1.1 ICT STATUS IN THE REPUBLIC OF MACEDONIA

The Information and Communications Technology (ICT) represents a seamless convergence among the technologies dealing with information handling, software and communications, thus enabling the end-users with ubiquitous access, storage and manipulation of relevant information (Gavrilovska and Atanasovski, 2013). Nowadays, the importance of ICT is rapidly increasing and promoting end-users into modern and well-developed society. Focus placed on education in the 21st century address development of the information society in order to intensify ICT education and training, the computer literacy and especially the empowerment of youths (Stojanovska and Barakoska, 2016).

The Republic of Macedonia is one of the few countries in Western Balkan Countries (WBCs) that have recognized ICT as an important sector for its future growth. Different national bodies (including those for education) and universities have started a dialog on creation of curricula, which would fit the needs of modern ICT and will ensure that the Republic of Macedonia keeps the momentum in the area with the developed countries (Gavrilovska and Atanasovski, 2013).

The Republic of Macedonia boasts an impressive broadband penetration rate of 32% on a national level with 100% company Internet connectivity. Moreover, the Internet access in schools and Wi-Fi based public Internet access is already rolled out with very high percentage of national coverage including remote areas. Macedonian schools offer one web-enabled computer for every 1.45 children (ITU, 2012).

The ICT sector is a hot topic nowadays in the country as it is among top priorities of the Government. The sector its self is led by two strategical documents: Information Society Strategy and National Broaband Strategy.

The Information Society Strategy defines the economic, social and political vision of the knowledge based society through ICT development and application in all spheres of life. Its aim is to foster creation of modern and efficient services for the citizens and the business community. The National Broadband Strategy is aimed at bridging the digital divide and providing broadband penetration comparable to the EU level. The document complements the Government's efforts to promote the ICT as a stonemiles of the society for further reconstruction and development. The adoption of the strategies mentioned above led to an increase in the Internet penetration in the country and promoting the usage of ICT on a wider scale, thus making the Republic of Macedonia regional leader in the WBCs (UNDP, 2010).

Execution of the strategies and further development of the ICT sector in the country was through the Ministry for Information Society and Administration (MIOA) that closely monitors all ICT related developments. Also, MIOA is responsible for implementation of governmental ICT policies, thus contributing to the achievement of all objectives in the previously mentioned strategies. MIOA is in close cooperation with the Agency for Electronic Communications (AEC) and the Ministry of Transport and Communications (MTC).

1.2 VET SYSTEM IN THE REPUBLIC OF MACEDONIA

Although the overall literacy in the country is very good (more than 96% literate people), the difference in the educational structure between urban and rural community is significant. Substantial share (13,4%) of rural population above age of 15 has insufficient or total lack of education, 2,6% are illiterate and 10,9% have not completed primary education (MAFWE, 2014). As one of the measures to improve the literacy was the introduction of law for mandatory secondary education that was introduced in 2008. The Government is also subsidizing the costs for education in terms of provision of free books and educational material for all scholars, IT equipment and internet connections of schools and free transportation of the students in the rural area.

Strategy for Vocational Education and Training (VET) of Republic of Macedonia and Action Plan 2013-2020 . The main goals covered by the VET strategy are:

1. To enhance the attractiveness, relevance and quality of VET and enable it to play a key role in the improvement of professional performance, competitiveness and innovation;

2. To offer more diversified and flexible learning opportunities to young people and adults to acquire the skills that are necessary for their career development and that stimulate entrepreneurial spirit, whilst fostering participation in further education and training, and contributing to active citizenship and personal fulfilment; and

3. To promote excellence and social inclusion, contribute to greater employability, mobility and job security enhance anticipation and management of labour market changes and encourage business competitiveness.

The VET system's use (at policy and providers' levels) of existing information on trends in the demand for jobs and skills is insufficient and unsystematic in the Republic of Macedonia. Apart from insufficient technical and resource capacity to deal with such information within the VET system, and the limited coverage of existing skills and studies, there are other constraints, mostly of a regulatory nature in adjusting specific curricula and providing of formal VET to respond the trends of the job market. Recent analysis (ILO, 2012), confirms skills shortages co-exist with a skills mismatch (over and under-education), especially affecting the competitiveness in the agri-food sectors. Enrolment in VET last decade, has been increasingly biased towards two occupational areas: economy and trade, which absorbs over 25% of students, followed by health science with approximately 19% of the students. The number of cohorts in other occupational areas, such as agriculture and veterinarian sciences has undergone a steady decline (ILO, 2012).

1.3 STATUS OF ICT IN THE EDUCATIONAL SYSTEM

There are numerous ICT educational centres offering education in various ICT areas throughout the country. Even though the life sciences are inherently present in every ICT curricula as a fundamental part, the number of dedicated ICT for agriculture programmes, especially in the universities, is quite low, almost zero. The majority of the higher education institutions and universities in the country offer an ICT curriculum. The most versatile programmes along with dedicated ICT are being offered at the largest university Ss. Cyril and Methodius University in Skopje (UKIM) (Gavrilovska and Atanasovski, 2013).

The initial steps of ICT introduction within the education process started after 2002, when the first donation from China in form of computerisation and digitalization tools was received and enabled a certain degree of mass usage of ICT at primary and secondary schools. Later, in 2005, the relevant institutions and expert working groups were established and started the implementation of the National Program on Education Development 2005-2015, the Draft Program on ICT Development in Education (2005-2015), the National Policy on Information Society and the National Strategy on Information Society Development that begin the encompassing process of computerization and digitalization of the educational sector in the Republic of Macedonia. Although marked by variable results, obvious is that "the process of intensified and mass use of ICT in education", which clearly paves the development of education in the Republic of Macedonia (Zhivanovikj and IPSOS, 2010). The project "Computer for Every Child" of the Government of the Republic of Macedonia, implemented between 2006-2012 in coordination with MIOA and Ministry of Education and Science (MES), anticipated the installation of 100 000 computers at all primary and secondary schools throughout the country, as well as provision of software tools for school subjects, acquisition of ICT skills, interactive on-line teaching and interactive teaching and assessment methods.

Therefore, we can conclude that a supportive educational infrastructure for ICT use in education so far has been created in the last decade. Namely, all primary schools are equipped with adequate ICT for the implementation of teaching, and series of teacher trainings for ICT in the teaching process were provided. Particular focus was placed on training of the teachers on how to use ICT in teaching process, due to the fact that if teachers were not trained properly for the application of ICT in the teaching process, it would result in inadequate and infrequent application of ICT among end-users, in this case, students.

Teachers of agricultural sciences, not just in WBCs, but also in Western Europe are faced with the dual challenges of accommodating students with lower farming literacy, while allowing them to catch up with the digital revolution. This requires new methods, and, possibly, stronger public support. In the Republic of Macedonia 11 agricultural-veterinary schools are currently operating, 5 agro-food processing and 8 for forestry management and wood processing. However, the number of enrolled students dramatically decreased from year to year and students' interest in these fields in general is very weak. In the academic 2013/2014 then number of enrolled students was 2450 which is almost half of the number of students enrolled in the academic 2011/2012 year.

In the country, apart from formal secondary and university education, there is a lack of additional (informal) education and vocational training, except the existing vocational training for crafts services. Smallholder farmers (especially in remote areas) have the weakest educational and professional level among agricultural producers. So far, very little has been done in terms of investments into education and training of agriculture producers and workers. Establishing a system for training in agriculture is in the focus of the Government programme for the period 2014-2018 (MAFWE, 2014).

1.4 EXISTING PRACTICES ON ICT IN THE VET SYSTEM IN THE REPUBLIC OF MACEDONIA

In 2010, MIOA promoted the project on free e-textbooks at the website www.e-ucebnici.mk that consists of 58 books, which contents are subject to free overview and browsing. The aim of the project was to enable students at any time and place, to master the learning contents in an innovative and interesting manner, while teachers by usage of ICTs prepare themselves.

The website www.skoool.mk, is a complementary project developed by the MIOA and the Bureau for Development of Education (BDE), which is a part of the global network www.skoool.com. The website provides tools and contents which include interactive audio and video materials that can be applied in the instruction process and contribute to creative presentation of relevant lessons. The contents are targeting primary and secondary education, and are related to the official curricula in the fields of mathematics and natural sciences.

The so-called Web 2.0 open broad space for creative use of ICT tools and Open Educational Resources (OER). Teachers with certain computer literacy more frequently utilize the possibilities offered by the Internet and new social media. For example, www.e-uciliste.com is offering on-line educational courses in: IT, physics, chemistry, electrical engineering, digital systems, etc., based on the Moodle concepts. The Moodle platform proved to be convenient for developing educational contents and courses. Unfortunately, its potential remains underutilized in the Republic of Macedonia.

2 METHODOLOGY

Aim of the analysis is to find out about current practices and to answer some specific questions related to VET teachers and their knowledge and experience of connecting digital tools for teaching agricultural topics:

1) How aware are agricultural VET teachers of trends in Farming 4.0/Agriculture 4.0?

2) How prepared are these teachers to develop their students for joining "connected agriculture"?and

3) Do they have a sufficiently strong ICT background in precision farming and ICT based systems?

In detailed, preliminary consultations with the all partners (who represent industrial and educational parties), the starting Situation Analysis assumption hypothesis is:

H0: There is a significant requirement for the provision of ICT training in these fields.

The results of the survey will provide directly usable information for the educational system itself, but its conclusions will form a very important input for the following working phases, including the development of the curriculum.

2.1 USED METHODS FOR DATA COLLECTION

For the situation analysis we used semi-structured questionnaire and did it through an online survey with 44 teachers from 6 different high-schools in the Republic of Macedonia that are having agricultural or veterinarian programmes. Two different, but crucial factors in the planning of the questionnaire were taken into account:

1) It must be directed to solicit information about ICT based teaching methods and tools;

2) It must be oriented to gather details of Farming 4.0 trends and systems therein.

The first approach was used to analyze and understand teachers' profile and their level of ICT knowledge and usage within the educational methods. Second part of the questionnaire was addressed to those that are more experienced in handling ICTs for agriculture and have a knowledge of some ICT tools. The questionnaire was consisted of 30 questions (multiple choice and open-end) divided into 5 chapters, such as: teacher's profile, teaching methodologies, current agro-informatics competence levels, current statement of ICT usage for agricultural VET education and teachers' knowledge on agriculture 4.0.

2.2 TEACHER'S SELECTION

Teachers selection was done by local project partners' experts that have several years of experience in VET for high-school. In the selection process for the teachers, surveyors were advised to put attention on those teachers that have more experience with usage of ICT tools within their teaching syllabus and facing problems with implementing such syllabus within their teaching methods. The output of the questionnaire should demonstrate an understanding not only of agriculture, but also of the latest agrarian informatics tools, the latest technologies and agricultural trends used by VET teachers in agricultural and veterinarian high-school in the Republic of Macedonia.

2.3 STATISTICAL METHODS

Interview data were extracted and summarized in 5 groups of answers per each topic covered in the questionnaire. Survey data was extracted in excel for further analysis (cross tabulation and frequencies).

Descriptive statistics are commonly used for summarizing data frequency or measuring central tendency (mean, median and mode). Authors used frequency analysis to answer most of the survey's questions. Frequency analysis is a descriptive statistical method that shows the number of occurrences of each response chosen by the respondents. Only in one case, mean was used as a descriptive statistic to interpret addressed question's results for better understanding by the readers. Cross-tabulation provides a way of analyzing and comparing the results for one or more variables with the results of another (or others). Cross-tabulation was used to interpret several simple data tables that present the results of the entire group of teachers.

2.4 LIMITATION OF THE STUDY

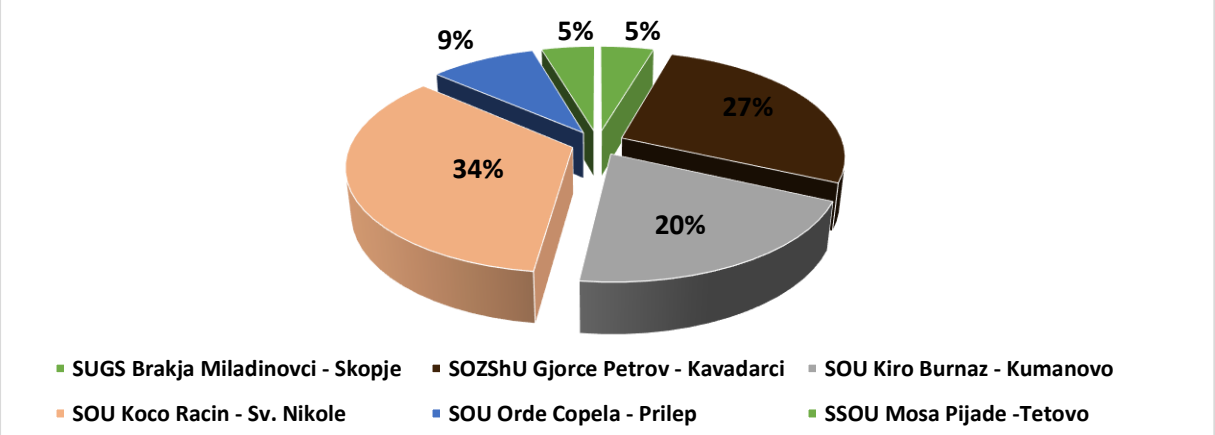
The main limitation of the analysis is the size of the sample of teachers that were analyzed. The size of the sample does not allow performing a complex statistical permutation. It is important to emphasize that all conclusions in the Situation Analysis report are in a form of indication and are valuable for designing hypotheses for further in-depth analysis on the relevant topic.

3 RESULTS

3.1 TEACHERS PROFILE

In total 44 teachers from 6 different high-schools in Macedonia were surveyed. The participants are coming from high-schools that are offering theoretical and practical education in agriclutural and veterinarian sciences. In addition, each school is from a different municipality and NUTS III region, thus we targeted schools that will give a sharp picture on the general statement in the country.

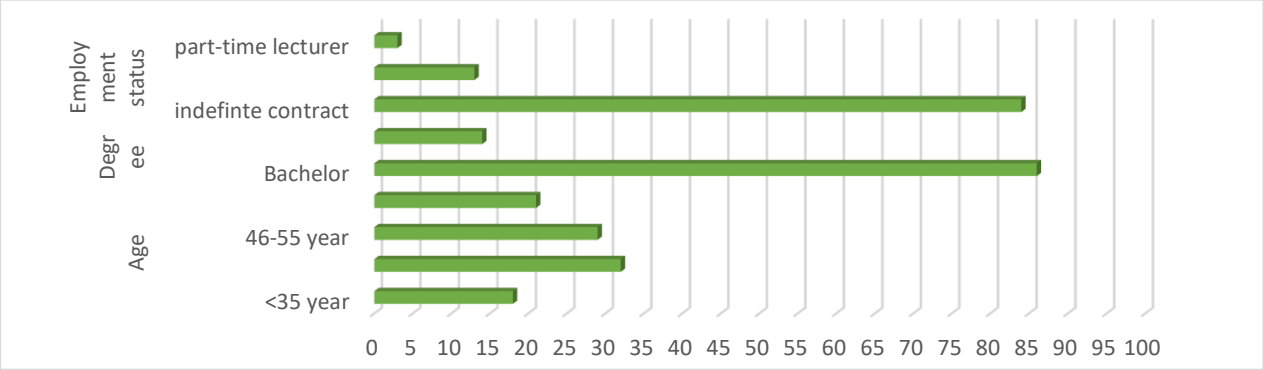
Figure 1. Number of respondents per surveyed high-school



Source: Agriteach 4.0, Erasmus+, project survey, 2018.

Most of the surveyed teachers come from Municipal High School "Kocho Racin" – Sveti Nikole (34%), representing one of the strongest agricultural and veterinarian high-schools in the country, especially in the Eastern Region. Second most represented is Municipal High School for Agricultural and Forestry Sciences "Gjorche Petrov" – Kavadarci (27%), which is the biggest high school offering different forestry sicence modules. Third is Municipal High School "Kiro Burnaz" – Kumanovo (20%), followed by the other 3 schools which all together represent only 19% of the surveyed teachers.

Figure 2. Agricutural high-school teachers' profile (part I)

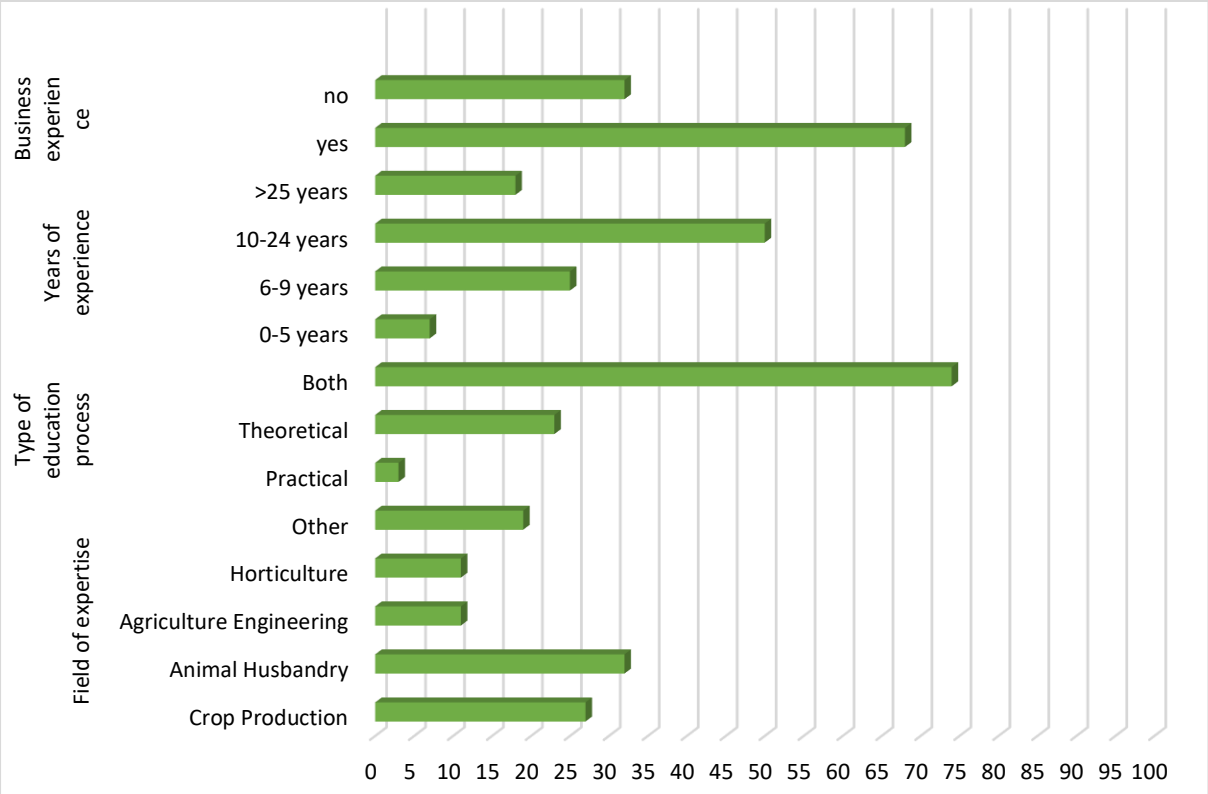


Source: Agriteach 4.0, Erasmus+, project survey, 2018.

A positive side of the general profile is teachers' age stage (Figure 2), that mostly represents 2/3 of the most productive period (36-55 years). Only 21% are above 55 years and 18% bellow 35 years old. This data give us a good basis for further development in the area of ICT for education, whereas theachers are at an age stage where reluctance to ICT adoption is still a challenge. As it was expected, most of the teachers (86%) are with a Bachelor degree. This is a reflection of the past political system and fast industrialisation that contributed to the high demand for educated labour force, and criteria for becoming a high school teacher was only bachelor degree, thus with only such condition, policy makers wanted to close the gap between supply and demand of teachers for high school education. Some of them (especially younger), hold Master degree too (14%). None of the teacher hold PhD title or are enrolled in post-master studies.

Most of the theachers (84%), have indefinite contract of employment. This might be due to the fact that agricultural sciences are not very attractive not just for the future high shool students, but also for the future teachers. Finding teachers in this field becoming more difficult for managerial staff of the high schools, thus offering indefinite contracts to their emmployees as the shortage of staff is visible in the country. In addition, 13% of the teachers are on a fixed-term contract, most of whom serve as maternity replacement or are on their first contract. It's not unusual for the high school managerial staff to offer fixed-term contracts for the new employees as a trial period. Only 3% are part-time lecturers, as their primary job is company based and they use their experience to transfer as knowledge to the students.

Figure 3. Agricutural high-school teachers' profile (part II)



Source: Agriteach 4.0, Erasmus+, project survey, 2018.

Besides teaching, most of the lecturers (68%) have experience within the business sector. Alongside theoretical knowledge they are offering practical expertise to the farmers or some companies dealing with agricultural issues. Half of the surveyed teachers have teaching experience between 10-24 years, and ¼ between 6-9 years. This represents a solid background for a target group that could adopt and use ICT tools through tailored workshops and piloting projects.

Providing both practical and theoretical education among teachers is ordinary process. Most of them (74%), are holding lectures that are divided in theoretical and practical parts. Depending on the subject and size of the curricula, it's usually 2+2 or 3+2 classes weekly where both practice and theory are delivered to the students. Another 23% are only involved in the theoretical part, and only 3% are providing practical knowledge to the students and it's related to animal husbandry.

Despite the fact that most of the interviewed teachers are from horticultural and animal husbandry departments, the picture of representing percentage shares by sector was expected. Animal husbandry teachers prevail in the survey with 32%, follwed by crop production 27%. Also, 17% of teachers represented in the results are delivering lecturers in other life sciences related subjects such as chemistry, biology, IT science, physics, etc.

3.2 TEACHING METHODOLOGIES

The methodologies applied for transfer of knowledge among surveyed teachers vary by type of method and general perception of the teacher for different methods. Commonly used method (73%) that is applied and well-known among teachers is "inquiry based learning". Taking into consideration the structure of the books and materials for agriculture that are based on inquiry based education, it was expecting surveyed teachers to point as most common method for knowledge transfer. Also, project method appears as second most used (59%), whose roots are coming from the transformation of the entire educational system in the Republic of Macedonia that switched to the Cambridge model programme and projects activities took large part within the curricula.

Table 1. Knowledge and use of some innovative teaching methos among teachers

	I know it and apply it during my lessons	**I know it, but I have not yet applied it during my lessons**	**I don't know it, but I would love to learn about it**	**I do not know it and I'm not interested in it**
Project method	59%	25%	16%	0%
Creative classroom	38%	27%	32%	3%
Flipped classroom	25%	23%	48%	4%
Problem based learning	54%	23%	20%	3%
Inquiry based learning	73%	18%	9%	0%

Source: Agriteach 4.0, Erasmus+, project survey, 2018.

Problem based learning (54%) is mainly used within the practical part of the curricula, where exercises contain problems and students' tasks are to find solutions through real or pilot tasks within the classroom or outdoor field. Knowledge of new methods such as creative or flipped classroom is known but not applied by the teachers. Additionally, those that don't know them are eager to learn about creative (32%) and flipped (48%) classroom teaching methods. Small portion (3-4%), especially elder teachers do not have willingness or eagerness to learn some new innovative methods and implement them within the education process.

It is not surpirisng that the current curriculum in the schools were surveyed teachers are working, do not include Vocational English for ICT classes. Most of the schools do not have such classes at the moment or within the teaching strategy for the forthcoming period. In some of the schools there were several piloting projects but nothing concrete came up as a final output. Most of the teachers were reluctant to the changes, taking into consideration their age stage and the old fashion methodologies they use, dating from the previous political system.

Table 2. Importance of skills that have to be developed among students

	very important	important	not important
Critical thinking, problem solving, decision making	82%	18%	0%
Creativity and innovation	75%	25%	0%
Communication	84%	16%	0%
Collaboration and teamwork	86%	14%	0%
Informatics literacy	75%	25%	0%
Sense of initiative and entrepreneurship, life and career	70%	30%	0%

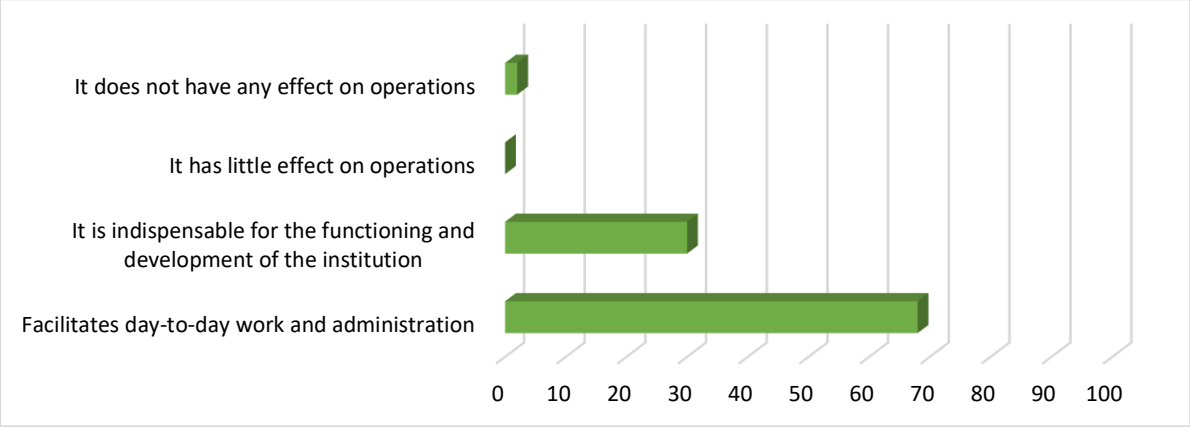
Source: Agriteach 4.0, Erasmus+, project survey, 2018.

From the results in Table 2. we can conclude that collaboration and teamwork (86%), communication (84%) and critical thinking, problem solving and decision making (82%) are most important skills that students have to posses or gain during the high school educational process. Rising debates and frequent discussions within the classroom are crucial for students to think outside the box. However, ranking less importance to the knowledge of IT (75%) and possesing IT skills in the teachers' perception is wrong pathway of deliberation, especially nowadays, where Agriculture 4.0 is present and affects the society. Another, critical remark is the importance of entrepreneurship and career skills (70%), that in teachers' views are less important than others. Such skills are highly saught after in the 21st century and the era of capitalism, where enterprise driven labour may become very sucessful, especially in the agricultural sector and farmers themselves. *Teachers do not have preception of the needs and skills that are on demand from the future recruiters in the private sector.*

The intorduction of online gradebooks and teacher's diary, makes the usage of ICT day-to-day work among teachers (68%) within their job place. Using of ICT tools like You Tube videos or some websites that contain

educational content for students makes teachers interact with them on a daily basis and to rely on their support within the educational process.

Figure 3. Level of ICT and technology that support the functioning and development of teacher's institution



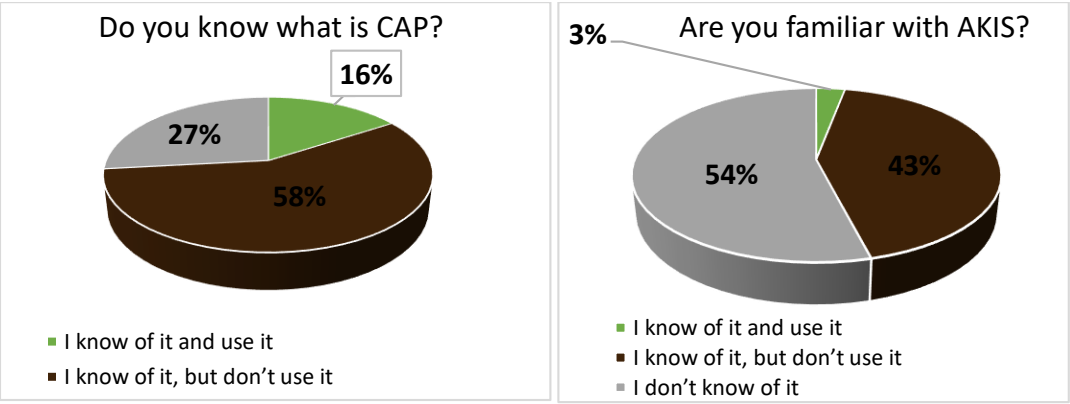
Source: Agriteach 4.0, Erasmus+, project survey, 2018.

In addition, 30% of teachers consider usage of ICTs and related technologies as indispensable for the functioning and development of the institution and the educational programme as well. Only 2% of teachers are thinking that ICTs do not have any effect on the daily operation within the institution. Those are 60+ years old teachers who are not familiar with ICTs and aren't aware of the benefits nor the principles of their functions.

3.3 CURRENT AGRO-INFORMATICS COMPETENCE LEVELS

Taking into consideration that the National Agricultural Policy is following the pathway to the EU integration and harmonisation with the EU Common Agricultural Policy (CAP), it was expected that a large portion (58%) of teachers are familiar with its basics and principles.

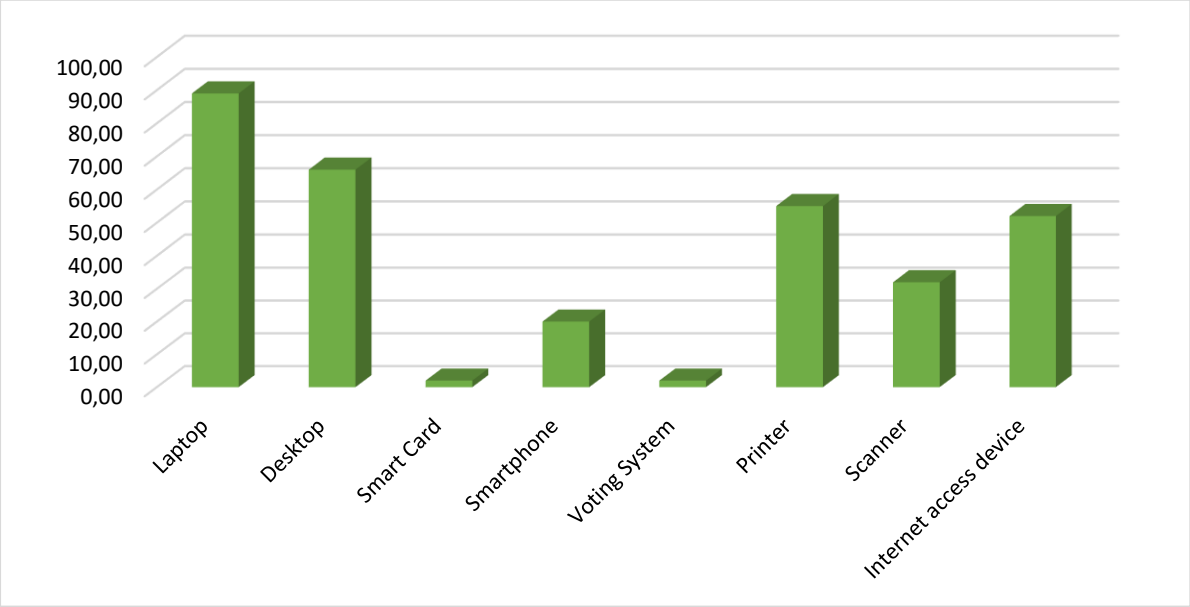
Figure 4. Teachers familiarity with CAP and AKIS?



Source: Agriteach 4.0, Erasmus+, project survey, 2018.

On the other side, 54% of surveyed teachers do not know what is Agricultural Knowledge and Information System (AKIS), or those who know (43%) are not using it within the curricula of their subjects. This fact is a critical point that has to be considered for further research, taking into consideration that teachers themselves are somehow involved in the AKIS at a national level.

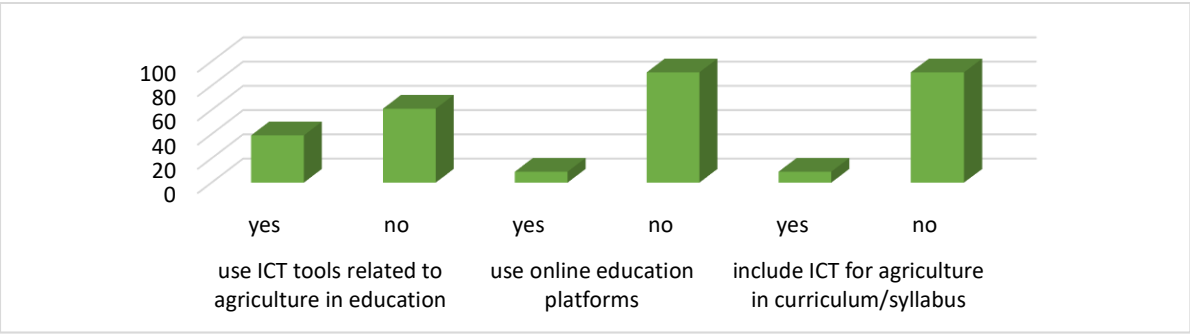
Figure 5. Level of use ICTs as a teaching tools



Source: Agriteach 4.0, Erasmus+, project survey, 2018.

The rise of percentage among teachers using laptop (89%) or desktop PC (66%) comes from the governmental project "Computer for every child", whereas teachers involved in VET were computerized and ICTs became compulsory tools in the daily interaction within the classroom and institution's administration. Additionally, the usage of tools such as printer (55%) and scanner (32%) is common and frequent among surveyed teachers. Printing and scanning teaching materials are common routines among teachers. Among teachers, there's a lack of familiarity with more complex ICT tools like Smart Card or Voting System.

Figure 6. Use of ICTs within the teaching activites



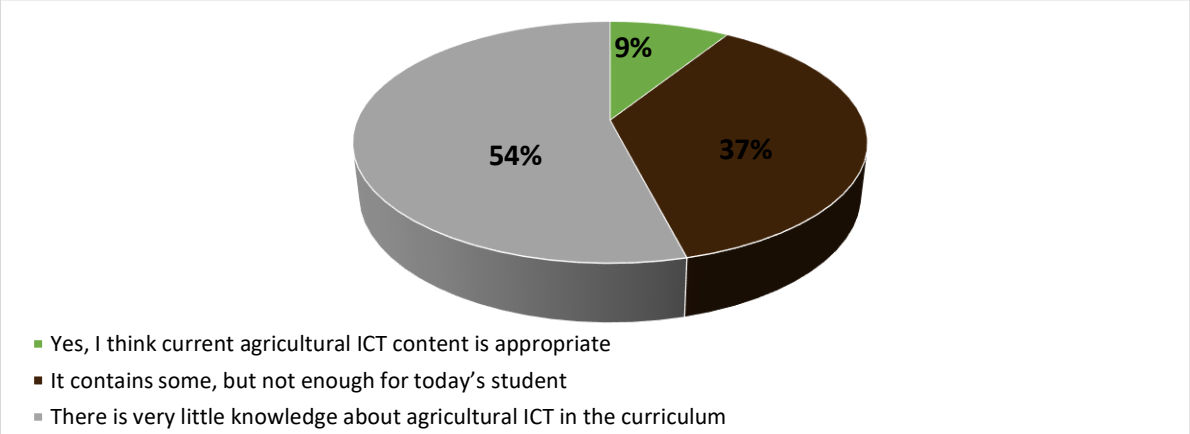
Source: Agriteach 4.0, Erasmus+, project survey, 2018.

Teachers mainly use laptop and desktop PC for browsing some information through Google, or showing some practical video through You Tube. Usage of Microsoft Office is ordinary tool in their teaching activities. In addition, one of the teachers use special software programme for early detection of plant desease at a given location. Usage of online platforms like Kahoot and Moodle is uncommon among surveyed teachers. Only 7% of the teachers are using them for teaching purposes.

3.4 CURRENT STATEMENT OF USAGE OF ICT FOR AGRICULTURE VET EDUCATION

Taking into consideration facts that arised from the results above, curricula that contain enough ICT content for agricultural purposes are rare (54%), as it was expressed by the teachers themselves.

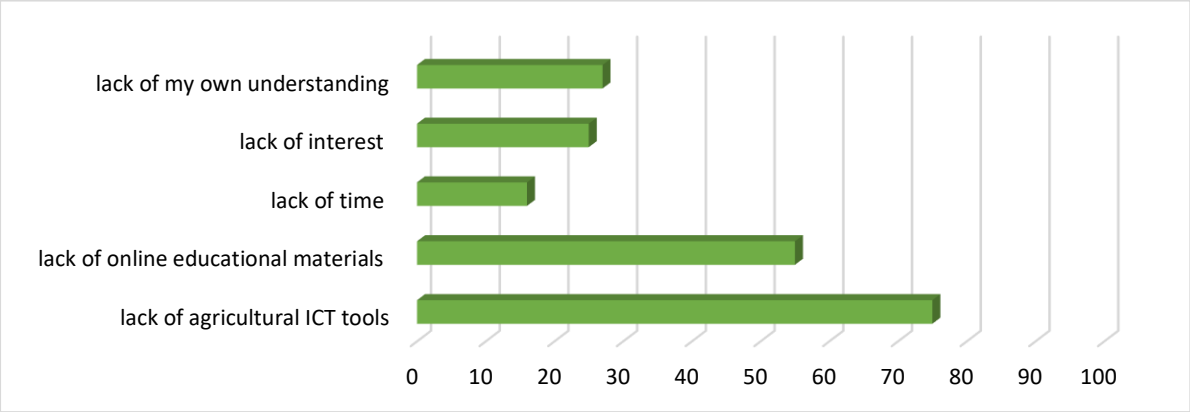
Figure 7. Contain of current curricula up-to-date knowledge of ICT tools for agriculture



Source: Agriteach 4.0, Erasmus+, project survey, 2018.

More than 2/3 of theachers think that some ICT content exist within the curricula, but does not satisfy the needs of today's millenal students. Only 9% of surveyed teachers think that current curricula contain enough ICT for agricultural education.

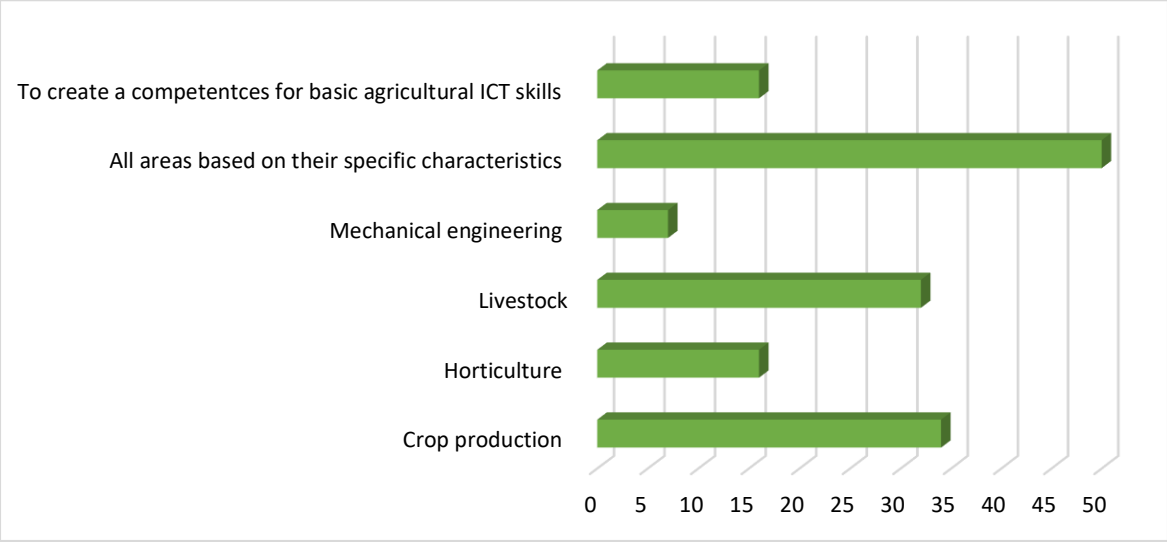
Figure 8. Factors that hinder teachers to incorporate knowledge and use of ICT tools



Source: Agriteach 4.0, Erasmus+, project survey, 2018.

Even though there are some basic ICT tools like laptops and desktop PCs, teachers think that incorporating of knowledge for ICT tools lies in the lack of such tools. This is a result of the teachers' perception for the definition of ICT tools. As most of them are not aware and do not have deeper knowledge, excuse like lack of ICT tools is expected. Also, lack of knowledge for online educational materials and tools like Moodle, Kahoot and some other localised e-learning platforms mentioned in section 1.4 of this SA report brings such results. *From the results in Figure 8, we can conclude that teachers are not well informed about the opportunities of ICT tools that exist and circulate around them*.

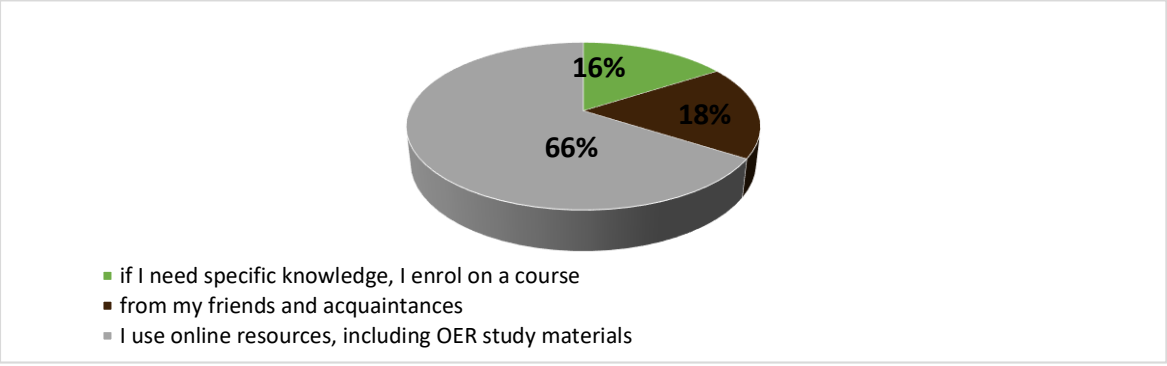
Figure 9. Areas that would be most useful to introduce the teaching of agricultural ICT



Source: Agriteach 4.0, Erasmus+, project survey, 2018.

Based on the results, it seems most of the teachers are looking for introduction of ICT in the areas they are specilized in. As most of surveyed teachers are coming from crop production and animal husbandry departments, it's understandable that we get results as they are presented in Figure 9. Also, teachers are looking positive on ICT introduction in the entire agricultural, forestry and veterinarian curricula (50%).

Figure 10. General enhancement of teacher's own ICT competences

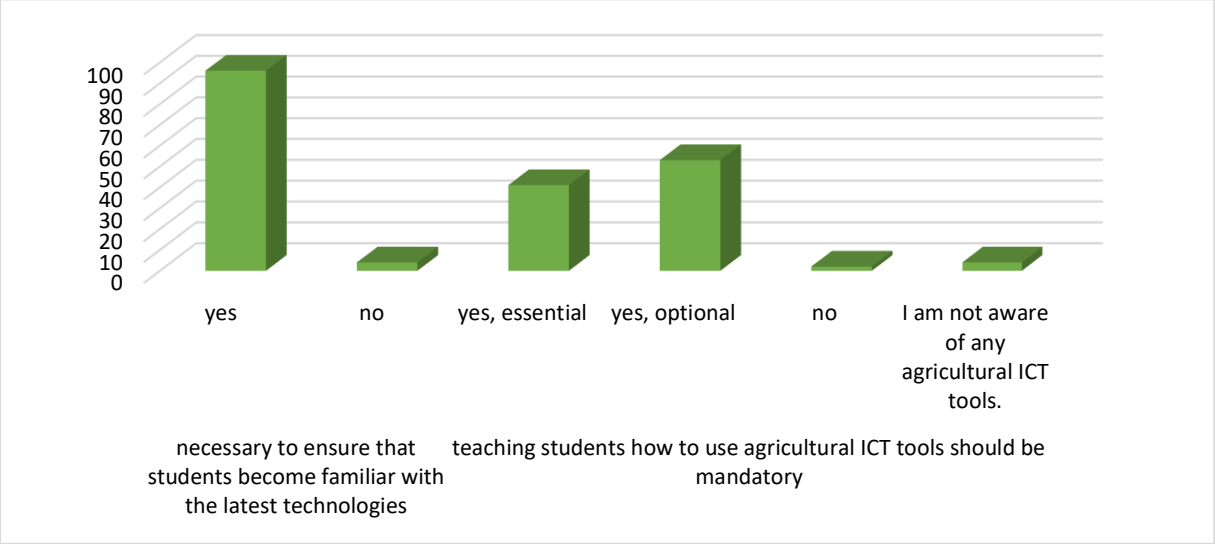


Source: Agriteach 4.0, Erasmus+, project survey, 2018.

Those teachers that are interested in continious updating of their teaching performance and skills are using online resources and OER study materials (66%). Some of the teachers (18%) are looking for assistance, mainly from their younger colleagues who have more experience with handling ICT tools or some friends when a specific ICT knowledge is required. Those that do not want to rely on their colleagues or friends are enrolling courses for IT literacy that based on the place of living (rural or urban), is available any time, provided mostly by private IT schools or in some cases by govermental non-formal education programmes.

Participating in courses that will enable teachers to use and teach about ICT tools for agriculture is more than a need for surveyed teachers. All of them are looking for such events where they can acquire tailored skills for usage of such technologies and later on, transfer them into practice and knowledge for their students.

Figure 11. Students' familiarity with ICT from teachers' perspectives

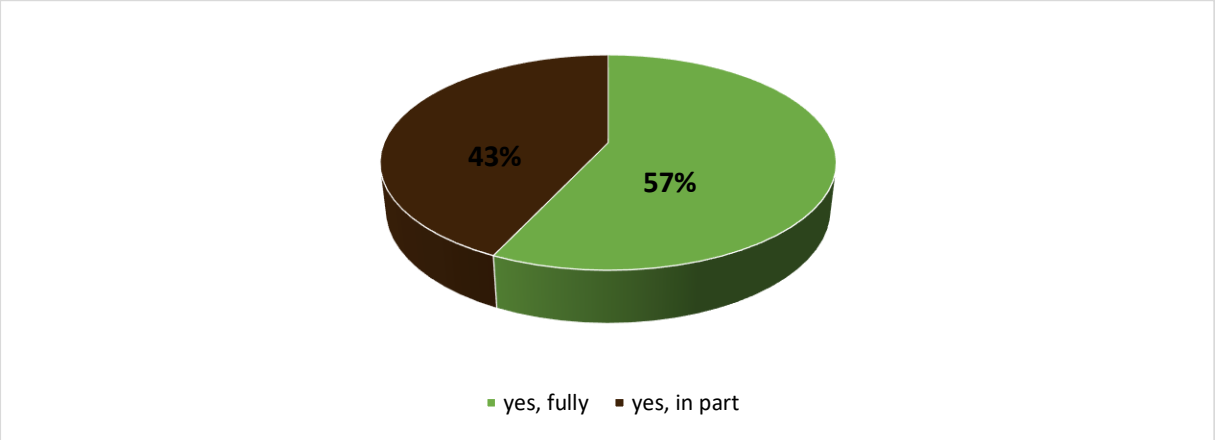


Source: Agriteach 4.0, Erasmus+, project survey, 2018.

Almost all of the teachers (96%) think that it is necessary for students to become more familiar with the latest ICT tools and technologies within the educational process. More than half (53%) of surveyed teachers think that usage of ICT within the classroom should be optional based on teacher's perception and capacity and on the other side 41% think that this should not be optional but mandatory within the teaching process.

The results for adopting ICT tools for agriculture within the curricula or not (see Figure 12), are indicating that all of them are willing to adopt them. But, not all of them (57%) agreed on full integration (43%). Some of the teachers are still sceptic about ICT in the process of agricultural education and their opinion leads to partial adoption, as some of the parts within the curricula have to be achieved through face-to-face work, especially in the practical part of the programme.

Figure 12. Teachers' willigness to adopt ICTs for agriculture in the curricula



Source: Agriteach 4.0, Erasmus+, project survey, 2018.

In Table 3. bellow (on scale from 1 to 5) some competecies like professional knowledge and skills are ranked on how important the teachers consider them to be within the ICT training.

Table 3. Professional knowledge, skills and other competencies teachers consider as important during ICT training (rank 1 to 5).

On completing an ICT course, a professional teacher should…	**Average**
Be able to enhance ones knowledge independently.	4.66
Know the meaning and use of agricultural ICT terminology - the basic definitions and terms.	4.53
Be able to search for current agronomic developments and descriptions.	4.51
Know and use appropriate pedagogical methods to teach the basic knowledge of agricultural ICT to students.	4.44
Know and use online teaching curricula, OERs and assessments.	4.41
Know the operation of various data transfer devices	4.34
Know how to use, install and operate various agricultural software tools	4.31
Be aware of the legality and ethics of ICT tools.	4.23

Be aware of the basics of web page management, and in using general content management and administration features.	3.95
Know the basics of installing and operating e-agriculture detectors	3.95
Understand the operation of various agricultural hardware devices and the basics of their maintenance	3.92
Be able to program independently, to develop custom software that meets the specific needs of a company.	3.84
Know the requirements of e-administration for the enterprise (applications, returns, data services).	3.72

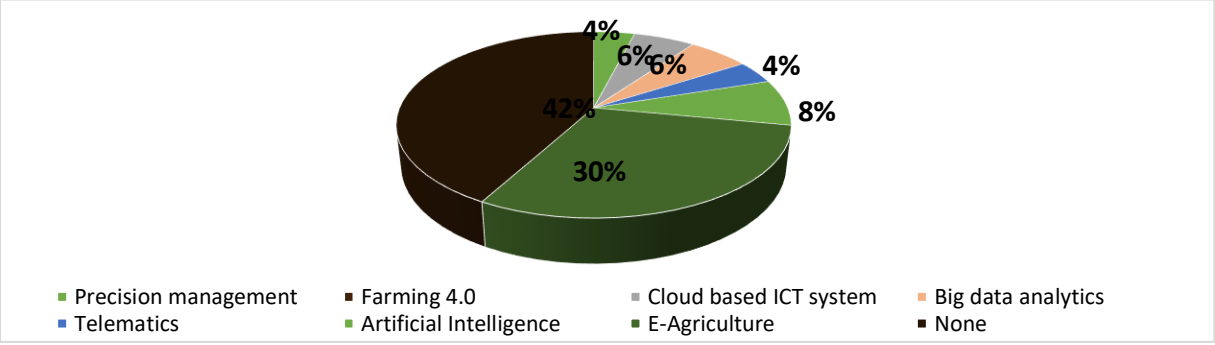
Source: Agriteach 4.0, Erasmus+, project survey, 2018.

On completing an ICT course, the most important benefit for a professional teacher is to be able to enhance ones' knowledge independently (4.66). Therefore, teachers' opinion on the knowledge and understanding of agricultural ICT terminology (4.53) and the ability to search for the latest agronomic developments and descriptions (4.51) is considered as very important. On the other side, knowledge on e-administration (3.72) or programming (3.84) isn't crucial to be acquired upon completing of ICT course among surveyed teachers. In general, knowing how to use and operate various software, use online curricula, OERs materials and pedagogical methods through ICTs are one of the key factors for successful competition of ICT course in teachers' opinion.

3.5 TEACHERS' KNOWLEDGE ON AGRICULTURE 4.0

Overwhelmingly, surveyed teachers do not have any basic knowledge (42%) on some agriculture 4.0 features like precision management, e-agriculture, telematics, etc. This is a dissapointing fact, taking into consideration that Agriculture 4.0 is already happening in the modern world. However, some knowledge on e-agriculture is good basis for developing and adoption of ICT into the curricula for the teachers in the agricultural education. Knowledge of Artificial Intelligence (8%) is also known among the teachers, but not enough for the sample represented in the survey.

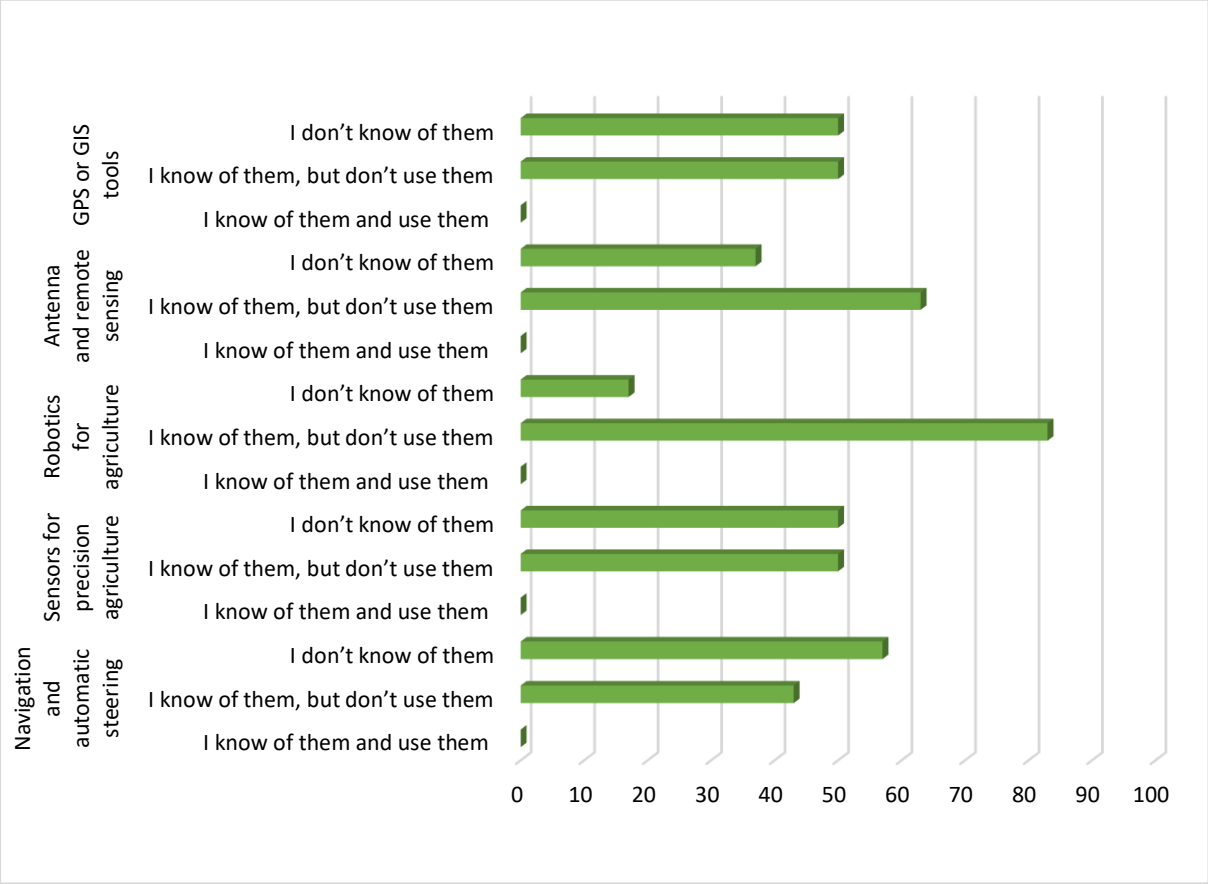
Figure 13. Basic knowledge of some Agriculuture 4.0 features among teachers



Source: Agriteach 4.0, Erasmus+, project survey, 2018.

Taking into consideration that the country itself is lagging behind with Precision Agriculture tools and Digital Agricultural Strategy (DAS), results from Figure 15 are realistic and expected. Not only the knowledge on policies like e-agriculture or strategies like DAS is lacking among teachers, but also the practical experience and knowledge on some of the basic digital tools (see Figure 13).

Figure 14. Knowledge and use of some modern technologies for Agriculture 4.0



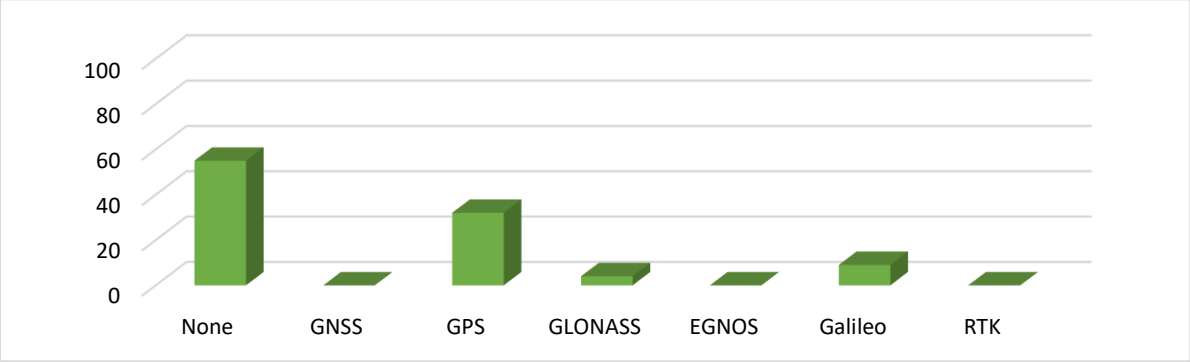
Source: Agriteach 4.0, Erasmus+, project survey, 2018.

Half of teachers have knowledge on GPS/GIS and another half do not know or have basic knowledge. None of the teachers have used or currently use GPS/GIS for educational purposes. Remote sensing is an attractive topic nowadays in the country and mostly younger teachers have some basic knowledge of their work (63%). Most of the teachers (83%) are familiar with robotics for agriculture. They have some knowledge gained through watching videos and some posts from the social media, but in practice none of the teachers have handled them before. Half of the teachers have heard or read about the work of sensors for precision agriculture but never used them. Due to the lack of sophisticated machinery in the country, knowledge on automatic steering and navigation is still poor (57%) among surveyed teachers.

Overall, due to the lack of modern technology within the schools for both theoretical and practical education, teachers do not have the chance to face and handle them and for that reason, they are not familiar or in most cases, they have some theoretical knowledge gained through the social media and

videos. Also, there's a lack of modern farms for practical education of the students in the Republic of Macedonia.

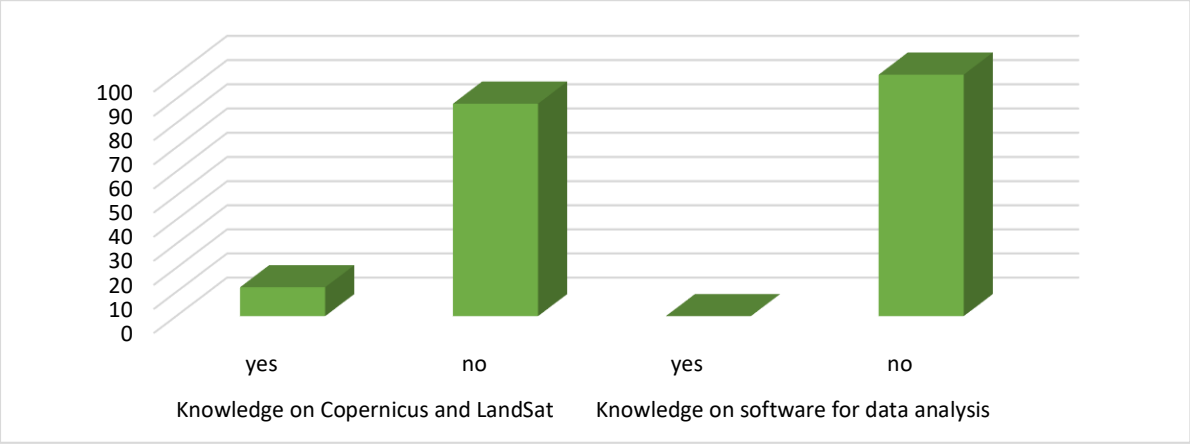
Figure 15. Knowledge of some navigation and positioning systems used in agriculture



Source: Agriteach 4.0, Erasmus+, project survey, 2018.

More than half of the teachers (55%) do not have knowledge on some well-known global navigation and positioning systems. This is expected due to the fact that teachers do not have perception and equipment/machinery to apply them. Some basic knowledge on GPS (32%) and Galileo (9%) is present among teacher, especially those teaching subjects related to agricultural machinery.

Figure 16. Knowledge about Copernicus, LandSat and software for data interpretation



Source: Agriteach 4.0, Erasmus+, project survey, 2018.

Those teachers that have knowledge on GPS and Galileo most likely have knowledge on LandSat and Copernicus, as well as the purpose and aim of these programmes. Teachers do not have knowledge on software for data analysis like Enterprise Resources Planning (ERP) or communication protocol like ISOBUS.

4 Conclusion

In the context of the agricultural education, from the aforementioned results it can be concluded that:

- Most of the teachers are between 36-55 years old, having 10-24 years of teaching experience and mostly have indefinite employment status. Their field expertise is mainly in the area of animal husbandry and crop production, but also areas like horticulture or mechanization are covered within the samples. Majority of the participants are participating in both educational processes: theoretical and practical part of the curricula. Many of them do not use ICT for agricultural education within the curricula. They do not have any ICT courses where they could gain knowledge on ICT tools for agricultural education process.
- Teachers are aware of the importance for ICTs, but the lack of ICT tools presence within the schools, makes their perception about the benefits and contribution to the educational system unknown. This statement is a result of the teachers' perception for definition on ICT tools. As most of them are not aware, nor have deeper knowledge, excuses like 'weak availability' of ICT tools is not representing the real situation. Unless teachers are not aware of ICTs and the future of agri-food sector, they cannot have perception of the needs and skills that are on demand from the future recruiters in the private sector.
- Inquiry based learning methodology is most frequently used by surveyed teachers within the educational process, that method is "old fashioned" and cannot find its place in the modern education nor be useful if applied alongside with usage of ICT tools. Nowadays, millennials are hyperactive students looking for more innovative approaches and methods like flipchart or creative classroom that are not familiar to the teachers. Also, the lack of knowledge for online educational materials and tools like Moodle, Kahoot and some other localized e-learning platforms mentioned in section 1.4 of this SA report brings such results.
- From the results, we can conclude that the teachers are not well informed about the opportunities for ICT tools that exist and circulate around them. In addition, beside the tools for theoretical education, the surveyed teachers have lack of knowledge and experience with digital technologies for modern farming like telematics, remote sensors, robotics, etc. Therefore, the teachers are not familiar with sophisticated ICT tools like those for Precision Management, big data analysis, ERP software, etc. Such disappointing results are a serious problem that today's VET system for agriculture is facing with in the Republic of Macedonia.

Relating to the European strategies and initiatives for e-Agriculture it can be concluded that:

- In general, agricultural VET teachers are not aware of trends in Farming 4.0 or Agriculture 4.0 that are present and most of the EU farmers are benefiting from their presence. As a country that is following the EU CAP pathway, such ignorance for the above mentioned topics is not acceptable. Especially, not for teachers in VET who play crucial roles in education process of further agricultural stakeholders like the high-school students.
- Implementation and introduction of ICT tools for agriculture is already established among the VET schools in Europe and their awareness and readiness have to be an example for the VET teachers in Macedonia. Development of curricula that include knowledge and handling of ICT tools for VET in agriculture is of a great importance for the future of the farming sector in the country.
- Most of the teachers are not aware of new methods of education, nor have the knowledge and capacity how to prepare their students to meet the needs of the private sector, especially big international companies that are dealing within the agricultural sector. On the other hand, the evident lack of modern technologies in both VET agricultural high-schools as well as agricultural companies, leaves the teachers with a limited choice of methodology to adequately prepare their students. Presently, they can only employ and transfer basic knowledge and skillsets. But, their

thinking beyond the current level and methods of education and bringing some innovations in preparing their students to respond and satisfy the needs of the future farming and agri-food companies is a missing masterpiece in their educational methodology.

- To catch up with the EU CAP and close the gap between the EU VET and Macedonian systems for education, in the field of agricultural education we are accepting the provisional hypothesis (H0) that "*there is a significant requirement for the provision of ICT training in these fields.*"

Regarding to the digital systems in Agriculture 4.0 it can be concluded that:

- Overall, due to the lack of modern technology within the schools for both theoretical and practical education, teachers do not have the chance to face and handle them and for that reason, they are not familiar or in most cases, they have some theoretical knowledge gained through the social media and videos. Also, there's a lack of modern farms for practical education of the students in the Republic of Macedonia.
- Overwhelmingly, the surveyed teachers do not have any basic knowledge on some Agriculture 4.0 features like precision management, e-agriculture, telematics, etc. However, some knowledge on e-agriculture is a good basis for developing and adoption of ICT into the curricula for the teachers in the agricultural education. Also, the knowledge of Artificial Intelligence is at a very low level and should be incorporated in the curricula for the teachers in the agricultural education.
- Teachers' excuse on lack of ICT or insufficient tools or practical farms for precision agriculture as their limitation for acquiring knowledge in this sector, is not a sufficient argument for arguing or a justification of the problem. The lack of opportunities for handling basic ICT tools for the purpose of gaining knowledge about their usage potential in the agricultural sector, or limited resources for providing tools for precision agriculture for educational purposes, is the underlying issue behind their statements.
- Even though the majority of the teachers use laptop and desktop PC's in their daily life, communication and education process, their knowledge and exploitation of ICT for the purpose of agricultural education is moderate. Continuous education of teachers about current and latest trends and innovations in the agricultural field have to be frequent and compulsory.

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