



**TECHNOLOGICAL CHALLENGES IN TEACHING
COURSES OF AGRICULTURAL INTEREST IN VOCATIONAL
UPPER SECONDARY SCHOOLS IN GREECE**

**Prodromos Skenderidis¹ⁱ,
Stefanos Leontopoulos²,
Vasilios Hatzitheodorou³
Vaios Liapopoulos¹**

¹Directorate of Secondary Education of Magnesia,
Pilot Vocational Upper Secondary School of Velestino,
End of Riga Feraiou Companions,
Greece

²Directorate of Secondary Education of Larissa,
Vocational Upper Secondary School of Elassona,
Mavrodimou bystreet 40200, Elassona,
Greece

³Directorate of Secondary Education of Magnesia,
Gymnasium of Velestino,
Velestino-Asprogia street,
Greece

Abstract:

The use of technology has entered in vocational education and training (VET), and there is a fundamental link between digital technologies and educational and pedagogical processes. The modern teacher must change his/her mentality and redefine his/her role from a simple provider of knowledge to a fellow traveller in the learning process, changing their pedagogical practices and promoting and successfully implementing digital technologies. The use of technology contributes to the activeness of students in the learning process and encourages individual learning and collaboration. Teachers can take advantage of students' interests and integrate technology into their classrooms, making learning effective and keeping them engaged in the lesson. This creates new opportunities for VET schools, teachers, and learners.

Keywords: education, digital technologies, vocational education, student, school, agriculture

ⁱ Correspondence: email mskenderidis@gmail.com

1. Introduction

In education and training, the scope for automation is more limited as the core task of teaching at the current state of knowledge cannot be easily divided into replicated sequences. Student populations are highly heterogeneous, and teachers have to adapt their teaching approaches to meet students' needs. However, digital technologies can complement and make the work of teachers more effective and beneficial to students, since technologies applied to teaching and training change the way in which knowledge is transmitted and skills are developed. For example, technologies can adjust the pace of learning to individual students' needs. Some aspects of education and training not directly related to teaching, such as management and administration, examinations and assessment, and data collection are more appropriate for automation, and in these areas, the introduction of technologies can generate efficiency gains.

Vocational and technical education is a type of education that belongs to the common core of school knowledge [1] and can be described as a form of education that prepares individuals for specific occupations [2] worldwide [3]. However, in some countries like Greece, vocational education might be the preliminary step for students to enter and study in higher education [4,5]. Thus, vocational and technical education plays a significant role in promoting community and national development worldwide [6,7]. Vocational and technical education helps students develop their practical skills via both classic teaching techniques and modern technologies, which instills in them the habits of creativity, invention, and resourcefulness. This helps them attain the aforementioned aims [8-12]. It is well known that throughout time, human activities in all fields have been dominated by continuous progress, the use of tools, and the achievement of technology. Though the rate at which new technical advancements are discovered has slowed down in the past, in the previous 50 years, technology has practically completely transformed every aspect of human life, including education [13]. The use of new technologies brings pedagogical advantages because they are not only an object of knowledge, which is a necessary tool for the technological competence of students, but also an unprecedented "multimedia" monitoring and cognitive teaching tool for all subjects by participating in the learning process. The integration of new technologies has emerged as a major educational policy issue due to the way of integration into each educational system, as well as the attitudes, problems, and effects on teachers and students from this integration. Every education system must, therefore, meet this challenge, which affects both the teacher and the learner and keep pace with the development of new technologies [14,15]. The use of new technologies as a learning tool should be such that it supports the provision of knowledge and learning rather than as a substitute for the traditional role of the teacher and conventional educational materials [16]. There is a widespread opinion that from the spectrum of possibilities offered by technology, only those possibilities should be selected that can lead to a change in the educational landscape and contribute to improving the quality of teaching. For this reason, educational experts emphasize that the pursuit of reforming the educational act is directly related to the continuous process

of modernizing the role of the current teacher [17]. Experts also point out that an important means for this modernization is the teacher's ability to effectively integrate and use information technology and other digital technologies in the teaching and learning process [18].

Students with acquired knowledge and skills can update their knowledge in a short time and redefine their professional identity [19]. Based on the above-mentioned, the possibility of using digital media in agricultural courses will be explored. Teaching a special course in Vocational Upper Secondary Schools (EPAL in Greek) needs a special approach. In contrast to other theoretical courses, factors such as the characteristics and abilities of the teacher, the abilities of the students, the teaching time, etc. play an important role in success. The teaching of specialized courses in agriculture also requires additional elements such as the laboratory equipment provided, the means of classroom supervision, the scientific and technological skills of the teacher, the abilities of the students, etc. [20,21]. In recent years, in many laboratory courses at EPAL, in addition to the above-mentioned classical way of conducting the course, the teaching of the laboratory exercise has been reinforced with standard polymorphic digital material in the form of images or with the projection of short videos so that each student can better understand the laboratory courses. Through the simultaneous use of digital media and technology, the teacher participates more directly in the process of student understanding of specific lessons and lab exercises, with benefits such as self-activity and feedback. For the above reasons, defining the teaching objectives of a specific course in agriculture education is the most important process.

From the teacher's point of view, the teaching procedure must be oriented toward the real needs and problems that EPAL graduates will encounter in the professional field. For this reason, the content of the training should be selected according to the criteria of what skills and theoretical knowledge a future professional needs to meet the requirements of the profession, i.e. each of the skills the student acquires should correspond to a skill that the graduate will need during his or her employment. It is also important that the teacher knows the content, employment conditions, and technological developments so that the objectives he sets correspond to the problems and requirements of the labor market. Particular attention should be paid to theoretical knowledge, as it is often not only difficult to understand but also does not contribute significantly to the acquisition of specific skills [22]. In general, we could say that the objectives should include only those abilities that are the result of teaching.

The purpose of this study is to present the common challenges, obstacles, and possible solutions to the integration of new technologies in an EPAL classroom, where courses of agricultural interest are taught.

2. Challenges arising from the use of new technologies in the teaching of courses of agricultural interest in Greek EPAL's

The need to use innovative methods in the learning of professional technical subjects in educational institutions defines the topicality of this subject.

Despite the fact that educational institutions are sufficiently equipped with technical teaching aids, teachers are often unable to provide students with the full range of knowledge required in modern times.

Electronic teaching aids based on modern three-dimensional computer simulations of physical processes and phenomena are realized in the form of multimedia teaching and research laboratories or virtual simulators. The argument in favor of the use of new technologies of virtual simulators is the active introduction of modern means of computer simulation and information technologies into the field of education as a new transdisciplinary area.

The main reasons for the use of virtual simulator technologies are as follows:

- The existing laboratory stands and workshops are not adequately equipped with modern equipment, devices and tools.
- Most of the laboratory stands and training workshops have been put into operation after they were taken out of production, do not meet modern requirements and are outdated, so they can falsify the results of the experiments and represent a potential source of danger for the students.
- The laboratories and stands have to be upgraded every year, which leads to additional financial costs.
- Areas such as building materials technology or physical chemistry require not only equipment but also consumables, raw materials, reagents, etc., the costs of which are sufficiently high.
- Modern computer technologies make it possible to see processes that are difficult to see in the real world without the use of additional equipment, for example, due to the small size of the observed particles.
- The use of virtual simulators makes it feasible to replicate procedures that are inherently impractical in laboratory settings.
- An additional benefit of virtual labs is their safety, particularly when handling chemicals or high voltages.
- It might be challenging to complete repeated analyses or verifications with some laboratory equipment within the allocated time due to the inertia of the job or procedures.

According to Georganta [23], the rapid development of information and communication technologies has created a new reality that has caused changes at all levels. The need to adapt the educational process to the technological reality requires the integration of digital technologies at all levels of the educational system. On the other hand, it also requires an appropriate commitment to improving technical education that meets modern educational and training requirements, taking into account the rapid

development and demands of the labor market [24]. The revolution that has resulted from the use of new technologies in education [25,26] is due to the change in which the student is at the center of the educational process, which brings benefits such as these:

- The learner can participate in the educational process from any location, repeating the learning material as long and as often as he/she deems necessary, adapting the educational process to his/her personal needs.
- It is a cost-effective method, and access to different educational platforms is easy for learners.
- It can involve a large number of trainees through a training process that knows no limits and places no restrictions on their number.
- It offers equal opportunities to all participants.
- It provides an attractive learning environment.
- Participants have access to various information materials (electronic libraries, etc.) via the Internet.
- It facilitates the monitoring of learning progress.
- The learning material can be reused.

In contrast to the advantages, however, the use of modern digital technology and information technology in education also brings with it some disadvantages and reservations [27-29]. These reservations are the reason for the resistance to adoption by the educational community. Some of the disadvantages of the use of information and digital technologies in education are a) the noticeable reduction of personal communication and contact between students and teachers, b) the beginning of a strong standardization of the teaching process due to the unlimited use of computers and other digital teaching tools, c) the contribution to social isolation of users due to their continued use of digital technologies and the internet, d) the impact on students' health such as fatigue, eye strain, headaches and back pain due to constant exposure to digital media radiation and immobility.

However, despite the ongoing drawbacks, information and digital technology is expected to enhance the learning experiences of students and teachers around the world by providing opportunities for collaboration and enriching learning opportunities for users [30].

3. Reference to the philosophy, ways, and means of dealing with information technology challenges

According to Koohang and Harman [31], e-learning is defined as: "*the delivery of education (including all activities related to teaching and learning) through various electronic media. Digital media could be the Internet, the satellite TV, the video / audio film, the smartphones, the digital software, the devices, and the platforms that are used as tools for learning*" [32]. The worldwide epidemic ultimately caused a change in schooling toward an online format. There is much debate as to whether it was a blessing or a curse.

The way that people see education has changed. While there were some early difficulties in adjusting to this shift, there were also some benefits. However, teaching using information technology tools is not always easy. Issues in teaching procedure could be said to be due to limitations regarding the lack of:

- technical support, equipment and resources,
- training and updating new technologies for teachers,
- accessibility by all,
- time.

3.1 Lack of technical support, equipment, and resources

Raising funds to finance the purchase of equipment to perform synchronized-asynchronous training is one of the biggest constraints [33]. Therefore, finding sponsors and funding support currently plays an important role in educational funding strategies [34]. The integration of new technologies into a classroom and the inadequacy of equipment and its connection to a network pose a serious obstacle to the application of any new technology and differentiated teaching method [35]. Being placed in a specific classroom, such as a computer lab and computerized equipment, also limits the spread of these technologies. Teachers are often thrust into the role of IT specialists as they are responsible for connecting devices and providing appropriate information to students. With additional technological support, teachers can be more responsive and focus solely on their pedagogical work. These limitations can be removed if the state and local authorities provide sufficient funding to purchase the necessary equipment. In addition, these limitations can be solved by hiring IT and network maintenance specialists and utilizing other premises owned by the municipality. It is also necessary to regularly replace the equipment with new ones, as technological progress is rapid. Finally, the participation of schools in European funding programs is recommended [33].

3.2 Continuous training and updating of teachers in new technologies

Although most schools have the necessary equipment to successfully run an electronic course, most teachers and students do not follow technological developments. It is common knowledge that most software programs are constantly being updated, and new programs are coming onto the market. Teachers and students need to constantly adapt to these developments in many ways in order to make the best use of these technologies [36-38]. However, during the covid-19 quarantine, both teachers and students themselves have significantly improved their skills in using electronic teaching tools [39,40]. Possible ways to deal with this goal are a) attending relevant seminars, b) providing technical support from software companies, c) collaborating with other colleagues to develop courses, d) posting teaching material and assignments on the e-class website, which should have the meaning of continuing the course after the end and outside the classroom [41].

3.3 Accessibility by everyone

One of the most important factors for successful teaching with the help of new technologies is accessibility [42]. There is no point in providing all the above factors if accessibility is not given. Accessibility is not only limited to the communication network, but also to access to the IT infrastructure. The combination of PC, network, interacting people, etc. is a basic requirement for successful distance learning with modern technologies. To overcome limitations, measures such as the use of open software, free access to IT infrastructures, the establishment of community technology centers, the development of high-speed networks, the provision of financial resources and cooperation with other school units are required [43].

3.4 Lack of time

A serious limitation is also the lack of time, especially if teaching is to take place in the classroom. For this reason, the teacher's preparation must be such that possible delays during or shortly before the start of the lesson are taken into account. Collaboration between teachers and the use of e-class and e-me platforms and other equivalent asynchronous education programs offer students the opportunity to follow lessons at any time [44,45].

4. Application of new technologies in teaching courses of agricultural interesting Vocational Upper Secondary Schools

In the specialty in "agriculture sector" at Model Vocational Upper Secondary Schools (PEPAL) of Velestino town, digital media and technologies such as the use of videos in learning and assessment procedures, interactive digital boards, digitized textbooks, the use of tablets, the use of online platforms, online classes and other learning communities to assess information, 3D printing, the use of robots and automation and the use of mobile applications during the learning procedures of several modules are used. Regarding the use of smartphones, there are now several applications that address the full range of subject activities, from planning a garden to describing plant species, plant protection, fertilization of plants, nutritional value of food, climate change issues, weather forecast, etc., [46,47].

Regarding access to several educational platforms and scientific research articles, students in PEPAL of Velestino have access to several research articles written by their teachers that focus on a broad range of specialty activities, such as energy crops [48,49], waste management [50,51], plant protection [52-57], dairy [58-61], agricultural economy [62], food technology and bioactive ingredients [63,66], soil science [67,68], etc. Agriculture represents the main source of food in the world, but it is now facing serious challenges due to the increasing demand for food products, food safety and calls for environmental protection, conservation of water resources and sustainability.

The integration of new technologies has been recognized as a promising solution to address these challenges. Smart agriculture and precision agriculture have emerged as

a result of such discussions. Drones, also called unmanned aerial vehicles (UAVs), have witnessed a remarkable evolution in recent decades. The use of drones could improve the results of the teaching process, as the view from above of an area significantly improves the picture we have, and we can make better decisions about agricultural applications while storing the results and the decisions we make in the cloud for future use [69]. For this reason, students are trained in the applications of drones in precision agriculture (Picture 1) using also the data of the weather station installed in the school (Picture 2). Data from the weather station are also available on global weather networks such as WeatherLink, the Citizen Weather Observer Program, and Weather Underground.



Picture 1: Training of PEPAL students in drone spraying during an educational visit



Picture 2: Weather station (Davis Vantage Duo) on the roof of PEPAL of Velestino.
(The Weather station was bought via the program «A New Beginning in EPA.L.» (M.N.A.E.))

Experiential learning accompanied by didactic learning is the major training methodology in PEPAL of Velestino. For this reason, educational visits are made to international fairs, industries, universities and agricultural schools that present or have incorporated the new technologies in their processes so that students can see in practice the benefits of their use.

More advanced technologies in didactic and experiential learning can help diversify educational opportunities by overcoming material bottlenecks that would otherwise limit what governments and education providers can offer EPAL students and how students can progress. For example, virtual or augmented reality (VR/AR) and simulators can enable students to develop vocational skills by performing specific tasks, such as operating heavy machinery like tractors, learning to use digital agricultural types of equipment such as drones, applications of SCADA (supervisory control and data acquisition) sensors in a greenhouse, or testing chemical products or food analyses in a laboratory. In such cases, it may be cheaper and safer to use simulators or VR/AR than traditional labs, which are expensive to set up, maintain, and update. VR and simulators could also reduce wasteful spending in professions that make intensive use of materials or supplies, providing a more environmentally friendly and cost-effective alternative. They also have important advantages in terms of economies of scale, allowing them to be used in many different settings. In addition, the use of VR and AR has numerous benefits for employers providing training, as these technologies can reduce the time new trainees have to spend on real equipment, lowering the cost of training and thus providing a cost-effective supplement to traditional work-based learning. These applications of information and digital technologies in courses of various specialties of EPAL and PEPAL can be applied with relative ease, adapted to the teaching needs and limitations of the courses of each specialty. However, according to Biko and Tzifopoulos [70], the teacher's contribution to the expected upgrading of the educational process is ultimately combined with his professional development. But the factor that will add value is the pedagogical utilization of the use of the computer, networks, and the mobile phone and not just their technological dimension. An important factor for any reform is the teacher, who, with pedagogical knowledge and experience, learns and makes appropriate use of the possibilities of digital technology. According to Plomp et al., [17], the modern school is no longer the only way of dissemination of knowledge, but one among the multiple ones resulting from the combination of traditional and new means of disseminating knowledge and information. This admission is one of the important reasons that the educational policy of developed countries proclaims that the school must redefine its place in modern life and education.

5. Conclusions

Education using digital technologies is proving to be a reliable and fully satisfying prospect, replacing the conventional and inflexible traditional education model. Through the use of digital technologies, knowledge is made available to the recipient in a fully

interactive communication environment, customized to their personal needs and limitations. To summarize, the use of information technology and digital educational media is undoubtedly the most modern way of education that meets the educational needs of the social and economic context in which it is applied. The Internet can be used not only as a source of information, but also as a channel for communication and collaboration between teachers and groups of students participating in organized educational systems, allowing for spatial and temporal differentiation of the cooperating parties. Educators and new technologies are and should be interrelated concepts that lead to innovation, because educators and information technology complement each other. While computers use their unique power to guide and enlighten, human teachers will teach. Teachers will provide a purely human element to the educational process, while computers will provide information. We could say that in a modern education program, computers will guide and teachers will teach.

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About the Author(s)

Prodromos Skenderidis is a PhD and MSc holder related to Food Technology. He has been teaching in tertiary education for more than ten years. His research interests include food and educational technologies. He is an educator in the Directorate of Secondary

Education in Magnesia's region, particularly at the Model Vocational High School of Velestino. His publications are linked to the ResearchGate account: <https://www.researchgate.net/profile/Prodromos-Skenderidis>

Stefanos Leontopoulos holds a PhD in Plant Protection from the School of Agriculture of the University of Reading, U.K., and two Master's degrees in Plant Protection and Environmental Management from the Faculty of Agriculture of the University of Reading and the Open University of Cyprus, respectively after completing his undergraduate studies in the Department of Plant Production of the Technological Educational Institute of Larissa. He is an educator who has academic experience in various universities and institutions in Greece and nowadays is an educator in the Directorate of Secondary Education in Larissa's region. He has participated in various research projects related to crop production, food technology, and pedagogical issues by authoring 67 publications in peer-reviewed scientific journals, as well as in proceedings of Greek and International conferences. His publications are linked to the ResearchGate account: <https://www.researchgate.net/profile/Stefanos-Leontopoulos>

Vassilios Hatzitheodorou is an agronomist with postgraduate studies and a PhD. He is school manager of the Gymnasium of Velestino town in the Directorate of Secondary Education in Magnesia's region. He was a teacher at Vocational High School of Velestino for several years. His academic background and expertise contribute to the depth and breadth of this educational research.

Vaios Liapopoulos is a mechanical engineer with postgraduate studies. He has been the school manager for several years in the Directorate of Secondary Education in Magnesia's region, particularly at Model Vocational High School of Velestino. His academic background and expertise contribute to the depth and breadth of this educational research.

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