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ONLINE LEARNING TECHNOLOGIES AND SUSTAINABLE RURAL DEVELOPMENT: AN EUROPEAN PERSPECTIVE

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Abstract

An important factor for local communities is education. Education has a long-term influence on the community development. Education has significant differences between urban and rural regions. The purpose of this study is to analyse how the extent education can reduce these differences and particularly, the online education contribution to the development of rural communities. Also, the economic and social factors relevant for rural development were studied. This study utilized a qualitative analysis of statistical publications, academic literature, and official data from the European Commission and Eurostat. The results showed that online learning technologies provide several benefits for rural development, such as: easy access to knowledge, build new skills, exchange information with peers with similar interests, raising individual awareness of the modern topics like smart agriculture. Additional to the key factors there are challenges posed to the development of the rural communities, from which the digital divide, limited broadband coverage and the ageing of rural population that makes the online education less effective in rural communities. Through this study, it is given a contribution on how to improve the understanding of the role of online learning technologies in a sustainable rural development and to provide insights to various stakeholders, including national and regional authorities, entrepreneurs, educators and researchers.

Key words**:** *e-learning, online learning technologies, rural development, smart agriculture, sustainability*

INTRODUCTION

The COVID-19 period saw an unprecedented acceleration in the adoption of online learning technologies, both in terms of formal and informal education. Online learning technologies are defined as information and communication technologies (ICT) that use the internet via different devices to support learning activities in formal or informal educational settings. These include a wide range of platforms such as Open and Massive Online Courses (MOOCs), knowledge marketplaces, Learning Management Systems, gamification, online assessment systems, and collaborative platforms such as Zoom, WebEx, Microsoft Teams or Google Meets. These technologies, often synonymous with e-learning, digital learning, and virtual education, have improved access to knowledge by removing geographical and socio-economic barriers. With internet connectivity, online educational resources have become available to wider categories of users and, in many cases, have saved users' time and money. However, the accelerated adoption of these technologies in response to the COVID-19 pandemic has revealed both benefits and disadvantages. As benefits, it can be mentioned:
they provided flexibility, extended access to learning resources or improved communication and motivation. As challenges, it can be mentioned: issues related to digital division, content quality variability and the need for self-discipline among students. It is generally accepted that education is one of the essential elements of sustainable rural development [21]. E-learning technologies have an impact that is visible in both formal and informal education. These technologies can play an important role in upskilling, reskilling, and career change. Remote training and knowledge sharing through online learning technologies can be beneficial for rural regions. The online learning platforms can also promote other innovative approaches ortechnologies such as the Internet of Things (IoT) and help improve practices related to smart agriculture. The integration of IoT and smart agriculture

revolutionizes farming practices, making them more efficient, data-driven, and sustainable.

Courses offered through e-learning platforms can specifically focus on sustainable practices. The topics of these courses can include sustainable agriculture, water conservation techniques, and renewable energy use, directly contributing to sustainable rural development goals.

E-learning platforms can provide rural communities with access to various educational learning resources and courses. This includes specialized training in sustainable farming practices, environmental conservation, and renewable energy technologies. With e-learning, individuals can learn at their own pace and according to their own schedule. This is particularly beneficial in rural areas where residents may have to balance education with agricultural or other work responsibilities. By providing online courses tailored for EU learners current and future needs, the online learning platforms can help individuals to improve their digital skills and competitiveness [25].

The most common definition of sustainable development is given by World Commission on Environment and Development (WCED) and is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[29].

The United Nations (UN) established seventeen Sustainable Development Goals (SDGs**)** [28]**.** Among them, the SDG number 4 ensures access to quality education and promotes lifelong learning. Sustainable rural development, in the context of SDG 4, is essential. Sustainable rural development encompasses a holistic approach, aiming to improve living conditions in rural areas while preserving the environment [28]**.**

In European Union (EU), the SDGs are monitored, and periodically, the European Commission issues an evaluation of them. The SDG 4 monitoring concerns the progress in increasing and improving basic and tertiary education, adult education, and digital skills [13]**.**

Literature Review

In an older study, [20] stated that the "rapid evolution of Information and Communication Technologies (ICT) creates numerous opportunities for agricultural education and training." The authors argued that metadata interoperability is an essential element in achieving information exchange between online databases called learning repositories that store educational resources relevant for agricultural stakeholders. Similarly, in a more recent study, [23] stated that farmers need to acquire new digital skills to keep up with the progresses brought by Agriculture 4.0. Moreover, digital education provides easier ways to acquire new knowledge and skills.

[2] have demonstrated the utility of a plant identification quiz using a learning technology based on Excel spreadsheet quizzes. These sets of quizzes allow students to test their knowledge on the plants that were taught in a live course and to get quick feedback.

[27] conducted a systematic literature review (SLR) to identify dimensions and sub-dimensions relevant to sustainable development in rural territories. They found key sub-dimensions in the sustainability's social, ecological and economic dimensions and these authors suggested relating these to the SDGs for improving rural well-being. Within the social dimension, the author identified education as an important sub-dimension.

[18] examined how frugal innovation contributed to sustainable development in rural areas. The authors investigated how frugal enterprises contributed to specific SDGs and discussed implications for future research. [22] discussed the role of building rehabilitation in sustainable development and territorial cohesion in rural Europe. They emphasized the importance of heritage preservation and vernacular construction in rural settlements. [19] investigated the disappearing components of cultural heritage in rural areas of Poland. They proposed ways to utilize these components for regional development and to promote rural cultural heritage. [24] developed spatial farm models to assess agricultural development potential and defined farm types for multifunctional rural development in Poland.

[31] assessed the sustainable development of rural areas in Poland since its entry into the European Union. They used 38 indicators covering environmental, social, and economic aspects, identifying progress and challenges in rural sustainability.

[30] examined sustainable rural tourism in Poland, focusing on environmental sustainability and pro-environmental behavior. They identified sustainable development postulates being implemented in rural tourism and emphasized the protection of natural and cultural resources.

[6] investigated the role of social, economic and cultural aspects in the sustainable development of rural tourism in Romania (the Gurghiului Valley). They emphasized the importance of local entrepreneurs and the capitalization of natural and anthropic tourism heritage. [1] explored the potential of cultural tourism for sustainable rural development in Hărman Commune, Romania. They highlighted the importance of capitalizing on local cultural heritage to enhance local development and sustainability.

[3] explored the role of intangible cultural heritage (ICH) in sustainable tourism development in rural areas. They analyzed the "Marche Food and Wine Memories" project in Italy, emphasizing the need for local community involvement and networking with local businesses. [26] examined the impact of mining on local governance and sustainable development in a Swedish municipality. The study revealed a conflict between ideas of sustainable development and sacrifice, shaping local political stances on mining.

[21] examined the sustainable development in rural areas for five European Union (EU) countries (Germany, the Netherlands, Poland, Bulgaria and Romania). The authors argued that education is an essential condition for rural development while ensuring the required infrastructure. Moreover, they shown that the share of educated people in the analyzed countries has decreased. [7] analyzed the impact of food procurement on the economy of the rural areas. The authors asserted that high volume of food supply contracts associated with the requirements of sustainable procurement seem to be opportunities of development for enterprises from the rural areas. In a subsequent study, the same authors argued that public organizations have a substantial contribution to the development of sustainable agriculture and to achieving the sustainable development objectives in the food sector [8].

The list of studies reviewed above suggest that rural development is a multidimensional concept and besides agriculture, other activities such as rural tourism, development of rural businesses, preserving local heritage represents relevant topics in academic research.

In this context, the objective of this research is to explore the impact of online learning technologies in ensuring a sustainable rural development in Europe. Particularly, the study is looking into how the online learning technologies influence economic sustainability and activity diversification in European rural areas. In the current research, the authors have performed a literature review and document analysis.

In this paper, the following research questions are explored:

RQ1: To what extent do online learning technologies help promote sustainable rural development in a European context?

RQ2: How do online learning technologies influence economic sustainability and activity diversification in European rural areas?

The novelty of this paper lies in the analysis of the relevant socio-demographic indicators with an aim to identify the ways to increase the online learning adoption in Rural Europe.

This paper is organized as follows. The next section includes a description of the materials and methods used in this study and a literature review of the existing research regarding e-learning technologies and sustainable rural development. The paper continues with a general discussion of the results and their implications. Next, the paper presents the conclusions of the research and it concludes with the limitations and possible further researches.

MATERIALS AND METHODS

Document analysis

A significant number of EU official publications and websites have been reviewed in order to extract and compare relevant statistical data and themes for the current study.

Literature Review

The authors have performed an analysis of academic studies, journal articles, reviews and research reports that were published in academic journals indexed in major databases such as Web of Science, Scopus, Science Direct or Google Scholar, published in the past 15 years.

Data sources

In the current research, the public data sources from European Commission and Eurostat have been used. Specifically, the following official publications have been reviewed:

-Eurostat - Statistics Explained (including details regarding internet connection, devices used to connect to internet and the typologies of activities done via internet) and

-European Commissions' Rural Vision.

Scientific methods used to process the information have been as follows:

The authors have adopted mainly a qualitative approach, using various artefacts for comparative and content analysis. The objective was to extract relevant themes and context information for the researched topic.

RESULTS AND DISCUSSIONS

Eurostat territorial typologies

European statistics recognizes three typologies: grid, regional, and local.

Grid typologies are detailed statistics that differentiate three types: urban centers, urban clusters, and rural grid cells.

Regional typologies: under this category, there are metropolitan typologies that differentiate between metropolitan and non-metropolitan areas, and urban–rural typologies, which include a) predominantly rural regions, b)intermediate regions, and c)primarily urban regions.

Local typologies include the degree of urbanization criterion. Based on this, it can be differentiated into the following: a) cities, b)towns and suburbs, and c)rural areas. These entities will be used in the current analysis. The next level of granularity on this criterion (the second classification level) differentiates among cities, towns, suburbs, villages, dispersed rural areas, and mostly uninhabited areas [17]**.**

Socio-demographic and economic and perspectives of rural development in EU

According with official statistics (European Commission, n.d.-a), the population from EU's rural areas represent 30.6% of the EU's total population. Furthermore, the lowest percentage of individuals with ages below 50 are in rural and remote areas. What is more, the percentage of population at risk of poverty and social exclusion is larger in rural regions comparing with urban areas. In rural areas, based on the data from 2019, there is an employment gap between men and women of 13% [11]**.**

In 2018, in rural regions, the GDP per capita was only 75% of the EU's average, as illustrated in the Figure 1 below.

Furthermore, the GDP per capita in intermediate regions was 88% of the EU-27 average while in urban regions; this indicator reached 125% of EU-27 average.

This may suggest a common economic divide between urban and rural, with rural regions falling behind the EU average. The rural regions may rely more heavily on agriculture activities or may have lower levels of industrial or service sector activities.

These disparities may have implications on economic policies that may be needed to address the disparities between urban and rural and to ensure a more balanced economic and social development between these regions.

Besides GDP per capita, other indicators may be relevant to describe the economic development such as employment rates, income distribution, and access to various services such as healthcare, education or banking.

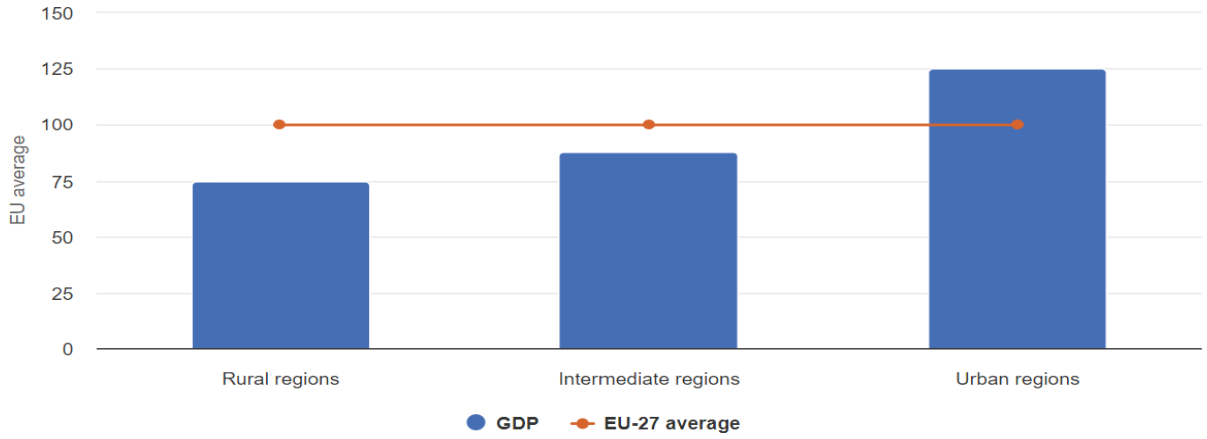

Fig. 1. GDP per capita, 2018, (percentage from the EU average).
Source: [12].

Internet connectivity is a major factor in the adoption of online learning technologies. The percentage of households in Rural Europe that are connected to broadband internet has evolved in the last decade. Table 1 illustrates this evoluti

Table 1. Percentage of households with an internet connection by connection type and degree of urbanisation in EU, between 2012–2021

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fixed broadband	54	60	60	62	64	66	67	67	69	70
Mobile broadband	16	22	28	33	39	41	47	51	56	56

Source: [14].

Both fixed and mobile connections among rural households have consistently increased since 2012 with the fixed broadband having a more gradual and steady growth. The percentages of households that adopted the mobile broadband more than tripled, increasing from 16% in 2012 to 56% in 2021.
After 2020, it can be seen that the mobile broadband coverage remained the same, indicating a possible stagnation.
The broadband internet connection allows accessing a wide range of resources including video and audio files, typically used in asynchronous online learning.
New technologies have emerged that allow internet connectivity on remote regions such as internet via satellites (such as Starlink that provides internet access services also in EU countries).
Furthermore, the share of people (16 – 74 years) accessing internet on a daily basis reached 80% at EU level in 2021, with a higher percentage in cities (84.4%) and towns and suburbs(80.6%) and a lower percentage in rural areas (73.82%). It is important to mention that the gap between urban and rural areas has narrowed gradually, reaching only 10% in 2021 [15].
Among the devices that are used most frequently by Europeans from rural areas to access the internet, the mobile phone or smartphone is the preferred device, regardless of the localization (rural areas, towns and suburbs or cities).
This suggests that this device is the primary mean to internet access to most individuals. Next preferred devices are the laptops and desktop computers and, on the last place was the tablet as illustrated in the Table 2.
For online learning utilizations, the best suited devices seems to be laptops and desktop computers due to larger display surfaces that facilitates the reading of e-textbooks and the consumption of videos as learning materials.
Smartphone and tablets might be used by learners for quizzes, various surveys, audiobooks and audio-recorded materials.

Table 2. Percentage of population (16–74 years old) accessing the internet, based on the types of devices and degree of urbanisation in EU, 2021

Device Type	Cities	Towns and Suburbs	Rural areas
Mobile phone or smartphone	85	81	76
Laptop	58	49	47
Desktop computer	36	34	31
Tablet	33	29	25
Other mobile device (1)	29	26	20

(1) Smart TV, smart speakers, games console, e-book reader or smart watch.
Source: [15].

According with the recent statistics [16], the activities for which the internet is used most often in EU are: sending and receiving emails (69%), instant messaging (63%), finding information on goods/services (61%), telephone or video calls (58%), reading online news (58%), internet banking (52%). There is another category of activities with a lower representation: doing an online course (13%), civic or political participation (14%), selling goods or services (16%), job search (10%). These were illustrated in the Figure 2 below. As it can be seen in Figure 2, the activities related to online learning attract a relatively smaller percentage of individuals from both urban and rural areas. In cities, on average 23% of individuals (17- 74 years) have used internet for online course, in towns and suburbs there was 17% and in rural areas only 13% of individuals did an online course. The lower usage across all categories in rural regions comparing with cities and towns suggests a digital divide that may have various causes. The low adoption of online courses in rural areas may suggests potential barriers such as low awareness, limited content in local language, or a lower level of digital skills.

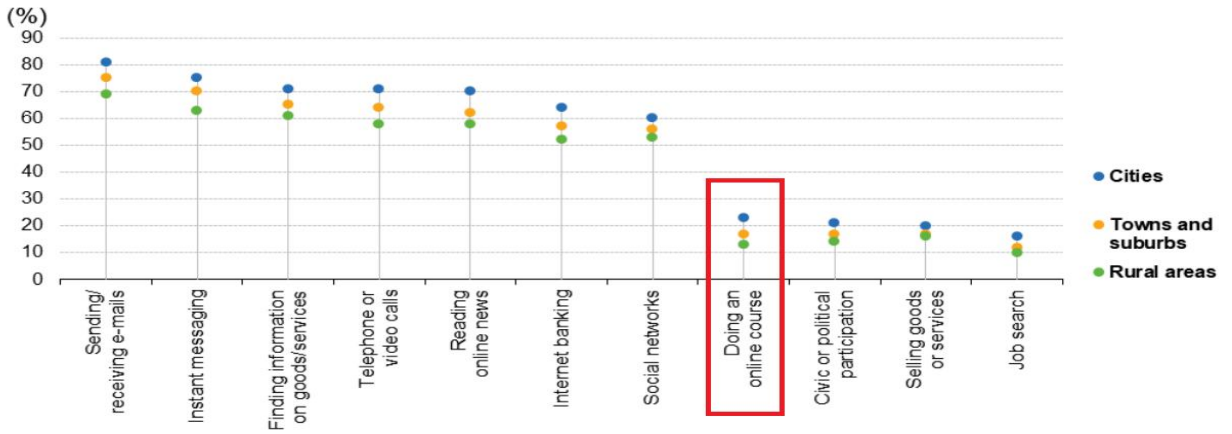

Fig. 2. Percentage of individuals (16–74 years) using the internet for various activities by degree of urbanisation, EU, 2021.
Source: [16].

Multilingualism and language literacy in EU

Currently, in EU there are 24 official languages [10]. Official statistics from EU from 2016 has shown that 35.4% of the adults on working age (25–64- year-olds) declared that they did not know any foreign languages. Table 3 below shows the percentage of working-age individuals that knew one or more foreign languages [10]. As it can be seen from the official data, covering nine years (2007 – 2016), there was a general trend toward learning languages between 2007-2011. Between 2011 and 2016, there was an increase in the percentage of individuals in the category "No foreign language" and a decrease in the categories "Two foreign languages" and "Three or more foreign languages".

Table 3. The percentage of individuals aged 25–64 based on the foreign languages knowledge in 2007, 2011 and 2016 in EU

Years	No foreign language	One foreign language	Two foreign languages	Three or more foreign languages
2007	37.0	38.4	17.7	7
2011	34.3	35.4	21.3	9.1
2016	35.4	35.2	21.0	8.4

Source: [10].

Speaking a foreign language helps individuals to be more competitive on the labour market and may improve workforce mobility.

The potential of online learning platforms and their offerings

ClassCentral.com – an online aggregator of offerings on online courses- has listed 204 courses on the topics related to agriculture delivered by various online learning platforms. Furthermore, on the topics related to tourism, 197 courses are returned and, for searches on topics related to sustainability, the aggregator displayed 662 online courses [4]. The following examples have been presented below in order to give an indication regarding the possibilities offered by a few of the online learning platforms.

Online courses from Coursera.org

Coursera–one of the largest learning platforms- has a wide range of relevant offerings [5]. Our search with the string "Agriculture" has returned 92 results. Furthermore, the platform returns 247 results on the search related to "sustainable development" string. See the Table 4 for a few examples of courses and their enrollment levels.

Table 4. Examples of courses from online learning platform Coursera

Course Name	Educational Institution	Language	Number of enrolled learners
Sustainable Agricultural Land Management	University of Florida	English / 19	40,483
Agriculture, Economics and Nature	University of Western Australia	English / 19	44,971
Discover Best Practice Farming for a Sustainable 2050	University of Western Australia	English / 19	38,623
Transformation of the Global Food System	University of Copenhagen	English / 19	23,454

Source: [5].

Most of the courses above are offered in English however, the platform has translated the content of these courses in more than 19 languages.

Online courses from EdX.org

EdX [9], another global online learning platform offers a significant number of online classes on agriculture related topics. Our search with the string "Agriculture" has returned 73 courses. In addition, the platform returns 202 results on our related to "sustainable development".

Table 5 presents for a few examples of such courses on online learning platform and their enrollment levels.

Table 5. Examples of courses from online learning platform EdX

Course Name	Educational Institution	Language	Number of enrolled learners
e-Learning on Digital Agriculture	The World Bank Group	English	13,438
Understanding Agribusiness, Value Chains, and Consumers in Global Food Systems	University of Adelaide	English	22,276
Drainage in Agriculture: controlling water and salt levels in the soil	University of Wageningen	English	7,808
WageningenX: Drones for Agriculture: Prepare and Design Your Drone (UAV) Mission	University of Wageningen	English	17,307

Source: [9].

The availability of the courses and their enrollment levels presented in Table 5 may vary depending on the time of the search on the platform.

The majority of the courses from the global learning platforms such as EdX, Coursera, FutureLearn are delivered in English language.

However, a substantial number of such courses benefit from translation in multiple languages. The above examples demonstrate the global reach and impact of these online learning platforms. The number of the courses delivered online will continue to grow year by year as shown in the official reports of these platforms. The learners from rural regions may find a substantial benefit and opportunities in attending relevant courses from these platforms in order to upskill, reskill or even change the job.

Rural Europe can benefit from a wider adoption of online education, both formal and informal as long as the basic conditions (internet adoption, availability of the devices and existence of basic digital skills and language literacy) are met. Online learning platforms have recorded substantial growth in terms of adoption of new learners and the development of their offerings. Top educational institutions around the globe have developed high quality online courses with a global audience that are delivered via internet in both synchronous and asynchronous format.

Challenges and opportunities

The availability of the computers or mobile devices, digital literacy and internet connectivity are pre-requisites for adopting online learning.

Lack of basic education and digital skills among rural inhabitants are also other barriers in adopting online learning technologies.

Another blocker is the availability of internet connectivity in the region at an acceptable price. Another barrier in adopting online learning in rural region is represented by the accessibility of these courses. The associated costs and the required language skills (English) may decrease the accessibility. The translations whenever available will increase the impact among learners and will help on the course comprehension. As EU is composed of a multitude of languages, besides a good internet connectivity, the delivering of the course in the local language may represent a substantial factor in adopting online learning.

Another point to consider is tailoring the course content for mobile learning. The mobile phones and tablets seems to be pervasive and many online learning platforms offer mobile applications as an alternative to accessing their web site. Accessing the courses via mobile devices will help the learners from rural areas to access their course content much easier.

CONCLUSIONS

The socio-demographic and economic indicators of rural developments presented in this study have shown significant differences between urban and rural areas. More than 30% of the EU population lives in rural regions. These regions face significant challenges, including:

-a higher percentage of the population at risk of poverty and social exclusion;

- an employment gap between men and women;

- a lower GDP per capita compared to the EU average.

Despite this, there is a positive trend in internet connectivity adoption among the EU's rural households.

Smartphones and mobile broadband internet connectivity are the preferred ways for rural inhabitants to connect to the internet. The pervasiveness of mobile devices and broadband internet connectivity are factors that can positively influence the adoption of online learning technologies.

Despite the good adoption of other internet activities such as sending emails, instant messages, internet searches, using social networks, or making telephone/video calls, the use of online courses remains relatively low in rural areas (13% of individuals). This may suggest a digital divide and potential barriers such as limited content in local languages or lower digital skills.

Another challenge is revealed by the fact that a significant share of the EU individuals at working age do not know any foreign languages. This has implications for labour market competitiveness and workforce mobility.

The examples provided, indicating the availability of online courses related to relevant topics such as agriculture, tourism, and sustainability, suggest the potential of online learning platforms to contribute to rural development.

Study Limitations and Further Research

The current research has considered only a limited number of online learning technologies, namely MOOC platforms. There is a wide range of online learning technologies that have the potential to help individuals from rural areas to gain access to quality learning content from anywhere in the world via an internet connection that deserves a closer attention. The EU Member states have recorded different levels of progress in adopting online learning technologies. The current study did not looked closely at these differences among European countries and these differences may influence the strategies to increase the share of online learning in Rural Europe. In addition to this, due to the extensive scope of the online learning technologies and sustainable rural development as well as the limitation on the number of pages, this paper could only provide an overview of the topic as opposed to a deep investigation.

Further researches may focus on the specific types of education such as formal education or lifelong learning as these may have different underlying motivations to access an online learning course.

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