



SUSTAINABLE AND WIDE-SCALE IMPLEMENTATION OF E-/D-LEARNING IN TECHNICAL VOCATIONAL EDUCATION

Dumitru IEȘEANU¹, Tudor BRAGARU²

¹Vocational School No. 2, Cahul, Ștefan cel Mare str.125, MD3309, Republic of Moldova

²Moldova State University, Chisinau, A. Mateevici str. 60, MD2009, Republic of Moldova

¹dumitruieseanu77@gmail.com, ²tbragaru@usm.md

Abstract. The sustainable development strategy includes simultaneous progress in four dimensions: economic, human, environmental and technological. The paper presents an express-study of good practices of sustainable and widespread implementation of electronic, mobile, distance Learning (e-/m-/d-Learning, EDL) in technical vocational education (TVE). For the successful implementation of EDL in TVE of the Republic of Moldova (RM), making changes, motivating, stimulating and continuously improving teachers, reducing the digital divide, etc. appropriate strategies and policies are urgently needed, both at national and local level for schools. *Purpose:* The paper aims to promote a conscious and responsible attitude towards e-transformation of TVE in the RM. *Methodology/approach:* The paper contains a brief analysis and synthesis of new challenges, trends and e-transformation solutions of TVE. Their awareness would allow a better targeting of the digital e-transformation of TVE from the RM. *Research Implications:* The post-pandemic world will have a greater demand for EDL. But many of the old paradigms, teaching-learning-assessment platforms, organizational solutions etc., need to be reviewed, rethought and adapted to the new conditions. Thorough analysis of good e-transformation practices of TVE is required in order to identify, adapt and apply appropriate solutions and scenarios under the conditions of TVE in the RM. *Practical implications:* Identifying transparent and effective ways/scenarios for preparation and provision of innovative education in TVE through sustainable and widespread implementation of EDL in vocational schools of the RM. *Originality/value:* A scenario of organizational e-transformation of IPT and sustainable implementation of EDL in IPT in the RM is proposed.

Keywords: Electronic-mobile-distance learning (EDL), EDL Platforms, Information and Communication Technologies (ICT), Sustainable Development, e-Transformation, Digital Educational Resources (DER), Continuous training of teachers.

1. Introduction

In the last five decades after the 1970s there have been elaborated and implemented various innovative e-/m-/d-Learning solutions: Learning

Management Systems (LMS platforms, e.g., Moodle, ATutor, ILIAS), MOOCs educational services (Massive Open Online Courses, e.g., Coursera, edX, Udacity), micro-learning, gamification and virtualization of educational content, etc., which led to reform and grow the educational productivity at all levels. This has allowed online distance learning to become the basic remedy in the situation of the COVID 19 pandemic crisis, which has forced the massive and "overnight" transition of traditional education to EDL. At the same time, this process deepened the digital divide, found a relatively poor level of preparation of the education system for organizational e-transformations of TVE in an emergency and in conditions of limited resources, insufficiency of teachers with the necessary qualifications. *Sustainable and widespread implementation of e/d-Learning in TVE requires the approval of an appropriate national strategy and corporate policies for e-Transforming TVE, automation and intellectualization of the development of digital educational resources, in-service teacher training, etc.*

According to UNESCO, rapid changes in the education sector, driven by COVID-19, have affected more than 70% of the total students. The rules of social distance have forced the replacement of face-to-face lectures with online solutions. "Physical closure" of schools, universities, colleges, etc. the "overnight distance" deepens the existing disparities in the education system and the emergence of others, some quite severe. For example, most PI do not have the necessary staff, ICT infrastructure and financial resources. Many students have limited access to computers, Internet, Wi-Fi. And where Wi-Fi is used as an Internet connection, it's not high-performing and reliable enough. Frequent interruptions of synchronous activities cause stress for teachers, parents and trainees, who are not yet accustomed to ICT.

In this context, the old paradigms, teaching-

learning-assessment platforms, including syllabus-technical solutions, need to be reviewed, rethought and adapted to the new conditions. A thorough analysis of the good international practices of e-transformation of TVE is required in order to identify, adapt and apply the appropriate solutions and scenarios in the conditions of the RM.

2. EDL as an innovation and e-transformation remedy for TVE

According to bibliographic studies, the concept of EDL is used in a broad and narrow sense. In a broad sense, EDL means the totality of educational situations in which the ICT means are used significantly. In a narrow sense, EDL is a type of distance education, as a planned teaching-learning experience organized by an institution that provides mediated materials in a sequential and logical order to be assimilated by students in their own way [1]. Thus, the original term taken from the Anglo-Saxon literature with the primary meaning of e-learning, is now an umbrella term [2-3] extended to the intersection of several educational actions mediated by modern ICT, gadgets, Internet and Web, Cloud Computing etc. (Fig. 1).

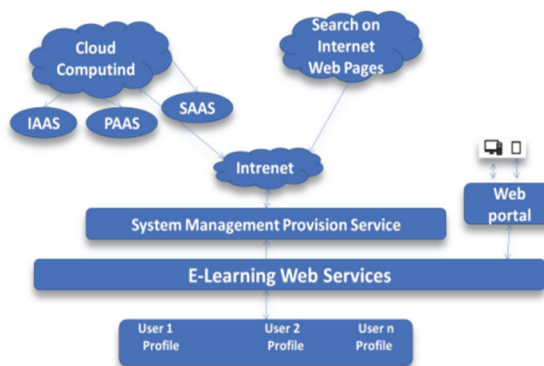


Figure 1. e-Learning services using cache management and Cloud computing [3]

Cloud consists of SaaS (*Software Application as a Service*), PaaS (*Platform as a Service*), IaaS

(*Infrastructure as a Service*). One of the biggest problems for the sustainable implementation of EDL in TVE is the lack of the necessary ICT infrastructure, qualified staff, limited finances, etc. [3]. According to many researchers, developers and software providers [4], [5], [6] the advantages, the benefits by using Cloud are multiple. Many educational institutions of various levels widely use EDL for academic courses, continuing education, corporate, vocational training, etc. Benefits for **students, teachers, and why companies are migrating to Cloud** services include:

- Minimal cost - Cloud means a significant decrease in the user's software and hardware resources, eliminates the entity's expenses for the acquisition and maintenance of ICT infrastructure, creation of IT departments, IT data centers, highly qualified ICT staff, etc. Everything the user needs - is a personal gadget (*notebook, smartphone etc.*) connected to the Internet;
- Cloud allows organizations to easily evolve to the scale needed to align with the requirements by accessing the relevant volume of resources at the right time, e.g., computing resources, storage, bandwidth, etc.
- High productivity and performance of those involved - Cloud eliminates the need to manage their own ICT infrastructures, no need for internal ICT assistance. Cloud services are configured-provided by professionals to the required parameters;
- Perfect collaboration in a distributed way - offered by the very essence of the Cloud and which is ideal for collaborative, remote EDL, but with reliable and secure learning platforms and resources, managed on the Cloud.

Basically, EDL in the Cloud is defined as a service. The service can be of the required quality, provided very quickly and at much lower costs, comparable to the time, speed and expenses required to deploy your own infrastructure. For the end user Cloud requires:

- An Internet connection;
 - Create an account with a username and password (by filling out a form);
 - Agreement with the terms and conditions of use.
- According to [7, 8], Cloud enabled organizations must have high-speed Internet.

In conclusion, Cloud EDL would be the "life-saving" solution for innovative e-Transform of TVE. Centrally managed digital educational platforms and resources in the virtual space on the Cloud save resources, increase their quality and allow the essential improvement of ICT-mediated teaching-learning-assessment processes. At the same time, it is worth mentioning that EDL, either with its own TPS infrastructure or in the form of Cloud services, with all their variety of digital tools, does not completely replace face-to-face classical education, but can significantly improve it and provides new interactive and effective forms of education.

3. Trends of Sustainable Development

The sustainability as a concept is the most often associated with sustainable development, a term introduced by the 1987 Brundtland Commission Report [9]. According to this document, sustainable development has three dimensions: *ecological, economic, equity and is understood* as a sum of actions through which "current needs are met without compromising the ability of future generations to meet their own needs" [10].

According to the PK-12 Model of Open Educational Resources for the New America on creating sustainable systems [11], the sustainability is based on four pillars: Access, Skill, Policy and Motivation (*Fig. 2*).

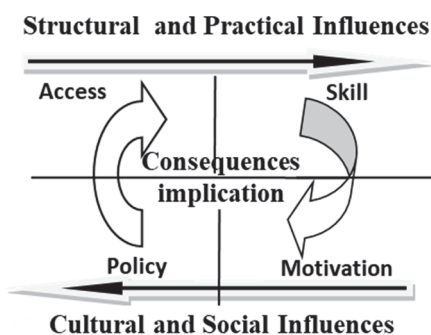


Fig. 2. Graphic representation of a sustainable process

The main activities of digital e-transformation of sustainable education and sustainable development strategies are exposed at European and national level.

At the global level sustainable development of the instructional-educational process is set out in 2030 Agenda for Sustainable Development [12], with the 17 sustainable development goals, which can be achieved by transforming unsustainable practices globally. The 2030 Agenda is an inter-governmental commitment and "a plan of action for people, planet and prosperity". For these reasons, UNESCO launched under the auspices of global education, the concept of education for sustainable development, which can contribute to a sustainable society by including the principles and values that underpin sustainable development in educational processes at all levels and ages [13]:

- Ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all;
- Focus on effective learning and the acquisition of relevant knowledge, skills and competencies;
- New focus on the relevance of learning, both in terms of vocational and technical skills for decent work;
- Concentration of all management systems (*government, united nations, society*) to address educational challenges and establish inclusive

and relevant systems for any participant in the educational process throughout life.

At the national level for the RM, Sustainable education development strategy for the years 2021-2030 [14] provides for the following factors:

- Connecting to international education policies: Implementing lifelong learning; implementing education for sustainable development as a key tool for achieving the goals of sustainable development; Ensuring the quality of inclusive and equitable education, etc.
 - Analysis of the real situation, general and specific problems, the potential and opportunities of the education system to achieve the goals of sustainable development and to effectively achieve its functions.
 - Establishing the prospects and opportunities for the socio-economic development of the country, which, for the most part, also determines the prognoses for the development of the education system.
- In this context, education, which is both an end in itself and a means of contributing to the achievement of the country's goals of social and economic development, must be seen as a foundation, in relation to other sectors of society; as a value and a tool for the production and promotion of values, ensuring continuity in the sustainable development of the country.

4. Sustainable implementation of EDL in TVE

Logic of the process of sustainable and large-scale implementation of EDL in TVE (*Fig. 3, Fig.4*) is based on ISO 20121 standard [15].

This specifies requirements for an event sustainability management system (SMS) for any type of event or event-related activity, and provides guidance on conforming to those requirements. SMS can be continuously improved according PDCA approach (*Plan-Do-Check-Act model*).

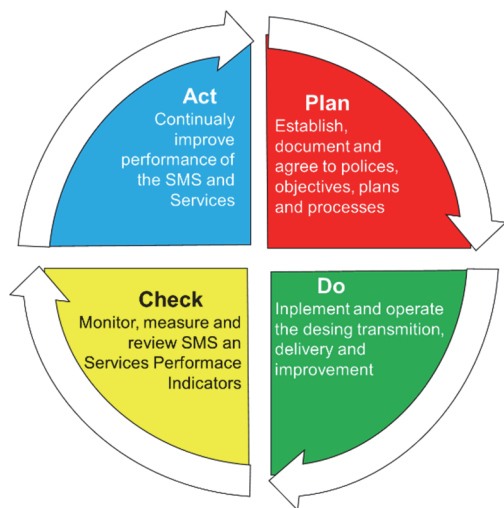


Figure 3. The PDCA cycle of continuous improvement of implementation events of EDL

For the TVE innovation process to be sustainable and widespread, it should be shaped by a well-defined strategy with sustainable innovation guidelines and policies:

- Defining the main goal according to modern trends;
- Determining the infrastructure appropriate to the needs and possibilities of technical vocational school (TVS);
- Appreciation of the level of awareness, continuous training and promotion of innovative EDL by top management, teachers and students;
- Control, maintenance and continuous improvement of EDL.

According to the results of the survey [16] and the data of MER (<https://mec.gov.md/ro/content/institutii-de-invatamant-0>), TVE in the Republic of Moldova consists of 13 Centers of Excellence, 36 Colleges and 42 Vocational Schools. According to the evaluation of the use of ICT in TVE [17] and the "Minimum Standards for ICT endowment of institutions in Technical Vocational Education" approved by the Ministry of Education and Research (MER) by order 1043 of 2015, the ICT endowment of TVE provides:

- Maximum 20 students per 1 computer; 50% of

computers older than years;

- Minimum 25 computers per institution (15 computer science class + 10 administration);
- 3 computers for management staff; 4 computers used by teachers; 2 computers in the methodical office; 1 computer in the library;
 - Minimum 2 printers per institution; 1 projector per TVE; 1 projection board.

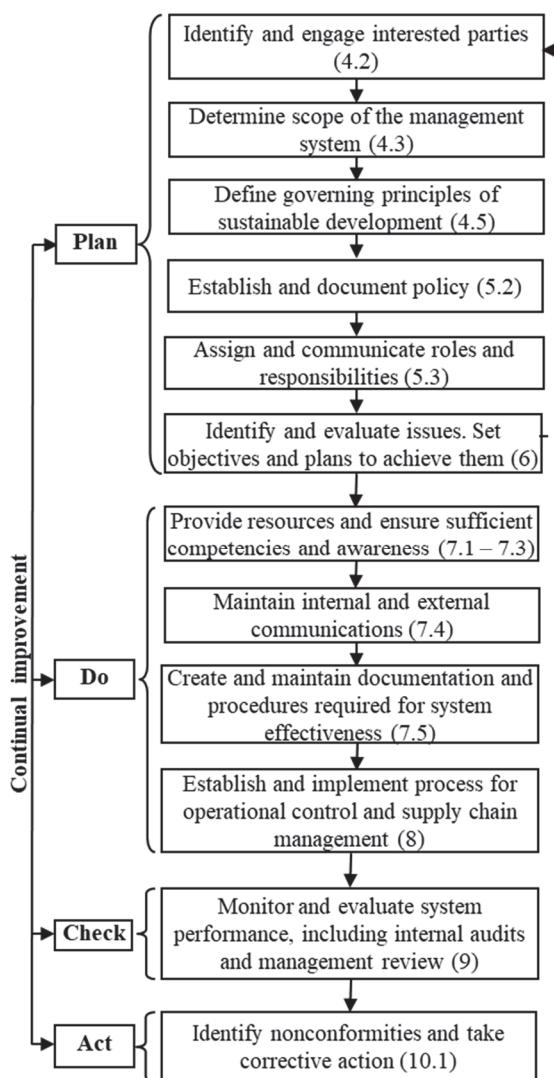


Figure 4. Event sustainability management system model for EDL [15]

But this endowment does not solve the problem of distance learning. For the development of EDL it is necessary that every teacher and every student involved has a gadget that can be connected to the Internet. The indicative assessment of the costs of equipping TVE with totally separate infrastructures

and in the conditions of the MER Single Center is presented in Table 1, based on the total number of 91 institutions, each with an average of 650 students, 50 teachers and 7 (*in the lowest current prices*).

Table 1

Indicative assessment of the cost of local infrastructure for the implementation of EDL in the TVS/Single Center for EDL Management

Product/service name	Unit price (lei)	Cost for an institution	Costs at the MER level (lei)
Gadgets for students	4000/ 3200	2600000/ 2080000	236600000/ 189280000
Notebooks for teachers	7000/ 5600	350000/ 280000	31850000/ 25480000
Internet connection (Fiber Mix 1000)	230/ 184	1610/ 1288	370300/ 296240
Serving the EDL platform	600000/ 10000	600000/ 10000	5460000/ 910000
EDL platform administration	3000/ 3000	3000/ 3000	273000/ 273000
Continuous training (for teachers)	350/ 15000	17500/ 0	1592500/ 75000
Google g-suite for education	1200/ 72000	1200/ 0	109200/ 72000
Total			276255000/ 216321440

We see that it is a rather large and unrealistic amount for TVE in the Republic of Moldova. The comparative analysis of the minimum endowment requirements of each teacher and student with at least one laptop/notebook in order to consolidate a sustainable EDL system with respect to the minimum standards of endowment of TVS, approved by MER, shows that the expected performance of ICT infrastructure is very weak,

practically insufficient, even if the minimum endowment standards involve a lot of costs and the separate infrastructures are difficult to manage.

We appreciate that creation of a single EDL center next to MER, which would manage all the necessary set of hardware-software resources, educational platform and DER for all TVS in the RM would significantly reduce costs (near 60 mln), at least for the problem of local VTS infrastructure.

The basic idea is that personal gadgets / laptops

should be cared for and belong to the individuals, and the care of the center is to facilitate/smooth the procurement and use of them and the centralized resources for the realization of VTE. Instead of dispersing resources, it is proposed to concentrate them and disseminate good practices.

ICT for VTS, could be delivered centrally by MER, in installments over a period of 2-3 years for students and up to 5 years for teachers. In turn, MER could directly contract the manufacturers for long periods of time, which would reduce the purchase, service and renewal prices of the ICT fleet. Google can also be contracted for the use of Google-suite, training on the territory of the RM, etc. Therefore, the only perspective for the sustainable and widespread development of EDL would be the creation of a Management and Control Center at the level of the TVE Directorate, which could:

- Collect the required amount (from centralization account) and reduce the summary cost at the level of each VTS (from the account of scaling and sharing);
- Implement and manage a unique platform for EDL, develop-manage-broadcast centralized DER, consult users, coordinate\ensure teacher training etc.;
- Organize common space for projects and teaching materials, organize competitions, exchange of good practices, etc.

A simple analysis of the alternatives shows a colossal saving difference of 59868760 mdl.

ICT technology can be purchased by the EDL Center directly from the manufacturer at a reduced price of about 20% compared to the commercial network. In addition, students or teachers may return used devices to the manufacturer for disassembly and modernization at the expense of new ones. But the most significant factor would be the sustainability of this system and the possibility of scaling, practically without any additional costs. The EDL Center would be an ideal solution, the most perfect and suitable, both for each of the VTS

and at the national level, ensuring the 4 dimensions of sustainable and large-scale development: economic, human, environmental and technological.

An example for the EDL Center would be <https://sime.md/>, which is a statistical data collection system, has a virtual catalog of videos, a user guide, and offers courses or seminars to reduce operating gaps. and data processing.

DER promotion competitions can be used as development opportunities, **organized by** Prodidactica (<http://DER.prodidactica.md>, <http://profesor.md>, <https://educatieonline.md>), by the ATIC Association (<https://tekwill.online>), Erasmus + (<http://erasmusplus.md>) and so on.

5. Results and discussions

Today, there is a wide and varied range of EDL platforms and solutions, including DER development. Identifying within each TVE a motivated team, concerned with the integration of ICT and EDL in educational processes, including motivating students, increasing the attractiveness of the learning process, increasing the satisfaction of students and teachers, efficiency in the use of ICT is crucial for:

Creation of the necessary conditions for launching and running EDL on a large scale by creating a Center;

Continuous training of teachers by categories (*e.g., beginners, advanced, experts*). TVE experts can carry out initial training for beginners, can conduct workshops with advanced ones in order to increase their skills;

Examining successes and failures, establishing the perspectives of EDL development-promotion, approving the good practices of continuous and sustainable innovation, etc.

Final conclusions

The post-pandemic world will have a higher demand for EDL, e-Transformation, e-Learning, e-Teaching, e-Training, etc. The integration of ICT in

TVE in the RM, sustainable and large-scale implementation of e-/d-Learning is a good development opportunity, but also an increased risk of failure, in the absence of awareness of new challenges and trends in post-COVID-19 education transformation.

The scattered activities of implementing EDL in TVE, carried out mainly in various scattered projects, local and isolated, are no longer effective. For the successful implementation of EDL in TVE in the RM, for change, motivation, stimulation and continuous improvement of teachers, reducing the digital divide, etc., sustainable strategies and policies are needed, both nationally and locally. of IP TV; coordinated efforts, involvement, commitment of the top management and teachers of IP TVE, systemic support at the level of the Ministry of Education and Research and other line ministries are required.

At the same time, today's EDL still cannot perfectly replace traditional face-to-face education, leaving room for further discussion, research and development, which we expect to happen in the near future. This involves the adoption of EDL implementation policies, the establishment of continuing education centers in the field of EDL, which will play a key role both in promoting innovative EDL and in developing new innovative forms of effective integration of ICT in the education of new generations.

Acknowledgment

This publication is based upon work from the SHELD-ON COST Action CA16226 Indoor Living Space Improvement: Smart Habitat for the ELDERly, supported by European COoperation in Science and Technology (COST). COST (www.cost.eu) is a funding agency for research and innovation networks, which help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers.

References

- [1].Grosbeck, G., Crăciun, D. Ghid practic de resurse educaționale și digitale pentru instruire online. Editura Universității de Vest, Timișoara 2020, pp.17-19
- [2].Alicia Cabezudo, Federica Cicala, Maria Luisa de Bivar Black, Miguel Carvalho da Silva. Global Education Guide. Drafting team, North-South Center of the Council of Europe, 2012 updated 2019, <https://rm.coe.int/prems-089719-global-education-guide-a4/1680973101/>, Accessed 22.03.2022
- [3].Khaleel M., El-Bakry HM, Saleh AA. Developing e-learning services based on cache strategy and cloud computing. International Journal of Information Science and Intelligent System. 2014; 3 (4), pp. 45-52
- [4].Report of the World Commission on Environment and Development: Our Common Future (1987) <http://www.un-documents.net/our-common-future.pdf>. Accessed 22.03.2022
- [5].Suicimezov, N. Cloud computing - An innovative solution for e-learning platforms. The 11-th International Scientific Conference eLearning and Software for Education, Bucharest, April 23-24 2015, pp. 125-128
- [6]. Homa Hamidi, Saeed Rouhani. The Effects of Cloud Computing Technology on E-Learning/In: Empirical Study, Robotics and Automation Engineering Journal, v2, n5, 2018, pp.1-7
- [7].Ghazal Riahi. E-learning systems based on Cloud Computing: A Review. /In: Procedia Computer Science, 62 (2015), pp. 352-359.
- [8].Gunjan C. Bhure, Sneha M. Bansod. E-learning Using Cloud Computing. /In: IJICT, v4, n1, 2014, pp. 41-46.
- [9].James V. Hillegas, Sustainability History Project September 23, 2010, <https://sustainabilityhistory.org/defining-sustainability/>, Accessed 22.03.2022
- [10].Katinka Weinberger. Integrating the three dimensions of sustainable development: A

framework and tools.

<https://www.researchgate.net/publication/292972333> Integrating the three dimensions of sustainable development A framework and tools,

Accessed 22.03.2022

Accessed 22.03.2022

[11]. Kimmons, R. (2015). OER quality and adaptation in K-12: comparing educator evaluations of copyright-restricted, open and open/ adapted textbooks. *International Review of Research in Open and Distributed Learning*. 16(5), 39-57.

[12]. Transforming our world: the 2030 Agenda for Sustainable Development, A/RES/70/1.

https://www.un.org/ga/search/view_doc.asp?symbol=a/res/70/1&lang=e, Accessed 22.03.2022

[13]. Unpacking Sustainable Development Goal 4 Guide-Education 2030, UNESCO, 2017, <https://unesdoc.unesco.org/ark:/48223/pf0000246300>, Accessed 22.03.2022

[14]. Programul de implementare a Strategiei de dezvoltare a educației pentru anii 2021-2030 "EDUCAȚIA 2030". [https://ipp.md/wp-](https://ipp.md/wp-content/uploads/2021/04/Strategia-EDUCATIE-2030-Versiunea_01.pdf)

[content/uploads/2021/04/Strategia-EDUCATIE-](https://ipp.md/wp-content/uploads/2021/04/Strategia-EDUCATIE-2030-Versiunea_01.pdf)

[2030-Versiunea_01.pdf](https://ipp.md/wp-content/uploads/2021/04/Strategia-EDUCATIE-2030-Versiunea_01.pdf), 165 p., Accessed 22.03.2022

[15]. ISO 20121:2012. Event sustainability management systems. Requirements with guidance,

<https://www.iso.org/obp/ui/#iso:std:iso:20121:ed-1:v1:en/>, Accessed 22.03.2022

[16]. Ieșeanu, D., Bragaru, T. Implementarea e-learning în școlile profesionale din RM. /In: *Studia Universitatis Moldaviae* nr.9(149), 2021, Seria „Științe ale educației”, pp.21-30, Accessed 22.03.2022

[17]. Bezedo, R., Mardare, A. Studiu de evaluare inițială a utilizării TIC în IPT [http://prodidactica.md/wp-](http://prodidactica.md/wp-content/uploads/2019/06/TIC-in-VET.-FINAL-.pdf)

[content/uploads/2019/06/TIC-in-VET.-FINAL-.pdf](http://prodidactica.md/wp-content/uploads/2019/06/TIC-in-VET.-FINAL-.pdf). *Prodidactica*, 2019, 94 p., Accessed 22.03.2022