

ICT methodologies for teacher professional development in Erasmus+ projects related to eLearning

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Abstract— The European Union promotes the development of European projects that provide relevant information on the methodologies used at educational level through different programs, including the Erasmus+ Programme. These projects are the source of inspiration for the research that gives rise to this article among others. This paper focuses on how teachers' professional development is approached using technologies within European projects related to eLearning under the umbrella of Erasmus+. The results show a greater representation of projects from the school education and vocational education and training fields. As its main results it could be highlighted that the most predominant ICT resources used by the teachers are those linked with office automation management, basic skills, and presentations as well as platforms for collaboration; those related to video and photo edition, the use of network resources and digital learning environment also stand out. Besides regarding ICT training the most frequent activities are "training by another teacher who has attended a course on ICT" and "Observation practices to other teachers who use ICT in their teaching". Variations between educational sectors are detected that may be the reason for a more in-depth investigation.

Keywords— Learning, ICT, teachers, European projects, COVID-19

I. INTRODUCTION

Nowadays, more than ever, it is necessary to have trained teachers able to face the continuous changes in our world so that they have the capacity for preparing citizens to perform their jobs successfully [1]. With the irruption of COVID-19 crisis social changes have been more evident [2] due to the fact that digitization has been promoted in all areas [3-6]. There are several papers that address these needs regarding how to adapt to new situations from different perspectives. This is the case, among others, of F. J. García-Peñalvo and A. Corell [7] analyzing digital transformation of teaching or F. J. García-Peñalvo et al. [8] proposing a guide of recommendations to help teachers and universities in the evaluation process due to COVID-19, as well as the OECD that has extracted some lessons for Education from COVID-19 [9].

There are many projects focused on the analysis and development of teachers' digital skills, for example, UNESCO has developed the ICT Competency Framework for Teachers (ICT-CFT) [10] which aims to assist countries in developing comprehensive national standards for ICT competencies for teachers and their inclusion into the school curriculum.

Moreover, there are many initiatives working on Objective 4 of Agenda 2030 in Education (ODS 4) [11, 12], in which the use of ICT is recognized as a key element [13].

Besides, the International Association for the Evaluation of Educational Achievement (IEA) coordinates the International Computer and Information Literacy Study (ICILS) that emphasizes the use of computers as tools for managing information and solving everyday problems as key elements of the current digital age, and in its latest cycle, in 2018, has included computational thinking (CT) [14, 15].

Towards those objectives works the Organization for Economic Cooperation and Development (OECD through its study Teaching and Learning International Survey (TALIS) [16] and the Programme for International Student Assessment (PISA) which its 2025 edition will include the innovative domain of Learning in the Digital World [17].

Furthermore, the European Union promotes the implementation of European educational projects with funding aimed to improve educational systems and the teaching-learning processes [18], especially through Erasmus+ [19]. With the projects developed throughout this Programme [20], which its new cycle has just started in 2021, new methodologies are implemented and explored to achieve improvements in training. In addition, specific projects are encouraged to assess the digital competence of schools, such as SELFIE [21] for centers and teachers, as well as platforms such as eTwinning [22], SchoolEducationGateway [23] and EPALE [24] that help to promote teacher collaboration.

This paper is based on a research work [25-27], that is focus on looking for the most outstanding educational practices that have worked adequately in a group of Erasmus+ projects linked to eLearning [28, 29] and Information and Communications Technologies (ICT). It presents the results obtained so far in those aspects related to the methodologies used by teachers. The following sections will describe the research methodology, the main results obtained, and the conclusions.

II. METHODOLOGY FOR THE RESEARCH

The research, reason for this paper, is being carried out following the guidelines specified in systematic reviews of research projects [30, 31]. This analysis of projects allows to get an overview of the current trends and identify the deficiencies and relevant results to define new lines of action in the research. Besides, it gives the opportunity to compare

between finalized projects and get a picture of how the technological ecosystems in the field are evolving.

At this moment the research is in the analysis phase of the collected results through a survey designed to gather information on key aspects of the projects regarding their degree of success and the ICT tools used.

In relation to the sample of projects with which we have worked:

- 1,144 projects matched the first three requirements established [25-27],
- 256 were discarded because they did not have any educational centers, another requirement of the study,
- 39 were excluded due to the impossibility of finding an email.

Hence, there were 849 institutions contacted of which 187 have filled in the questionnaire successfully. Therefore, the response rate has been of 22%.

A. Sections of the survey

The design of the survey has been based on different theories of questionnaire design [32-34]. Hence, it has been developed taking into consideration different models resulting in the end with a maximum length of 21 questions with dichotomous and open sub-questions for an average time of 20 minutes.

It has six sections and this paper is focus on the results obtained with the fourth section of the survey devoted to teachers and ICT.

B. Questions regarding teachers and ICT in Erasmus+ projects

As regards to the design of the questions for teachers and ICT the questionnaires of ICLS [14, 15], TALIS [16] and OECD PISA Global Crises Questionnaire Module [35] have been a source of inspiration. As a result, there are four questions (see table I): one related to the teachers' educational level, another one as regards as the ICT tools used within the projects, the third one related to the ICT devices employed and the last one in relation to the training activities carried out.

TABLE I. STUDENTS AND ICT SECTION

N.	Questions	
	Question	Options
1	What level are the teachers who have participated in the project? (select all that apply)	Q0009[SQ001] Early Childhood Education Q0009[SQ002] Primary Education Q0009[SQ003] Secondary Education Q0009[SQ004] Baccalaureate Q0009[SQ005] Vocational Education and Training Q0009[SQ006] University Q0009[SQ007] Adult Education Q0009[SQ008] None, no work with teachers in the project Q0009[SQ009] Other
2	What ICT tools did the teachers involved in the Project use? (select all that apply)	Q00010[SQ001] Basic digital tools (for example, software installation, Internet use, email, word processing, spreadsheets, graphics, file transfers, etc.) Q00010[SQ002] Presentations (Prezzy, Genially, Microsoft PowerPoint, LibreOffice Impress, etc.) Q00010[SQ003] Video and photo software for capture and editing (for example, Windows Movie Maker, iMovie, OpenShot,

N.	Questions	
	Question	Options
		Edpuzzle, Youtube, Adobe Photoshop, Illustrator, Inkscape, Gimp, etc.) Q00010[SQ004] Digital learning environment (e.g., Blackboard, Google Classroom, Moodle, Edmodo, etc.) Q00010[SQ005] Subject-specific digital learning resources (for example, tutorials, simulators, topic-related websites, wikis, blogs, encyclopedia, etc.) Q00010[SQ006] Concept mapping software (e.g., Inspiration, Webspiration, SimpleMind, etc.) Q00010[SQ007] Electronic portfolios for student assessment (for example, Mahara, VoiceThread, Moodle portfolio, etc.) Q00010[SQ008] Games for digital learning; programs or applications where you ask students questions (for example, Hotpotatoes, Quizlet, Kahoot, mentimeter, etc.) Q00010[SQ009] Augmented virtual reality software and activities Q00010[SQ010] Simulation and modeling software (for example, NetLogo, Matlab, Inventor, etc.) Q00010[SQ011] Development of applications or programs (computer programs, scripts or applications, using, for example: Scratch, AppInventor, Tynker, Code.org, Alice, Minecraft Code Builder, Logo, VBA, Java, etc.) Q00010[SQ012] Collaborate with other teachers via ICT (e.g., Google Docs, OneNote, Dropbox, vox, Zoho, Padlet). Q00010[SQ013] Communication with parents and / or students via ICT (e.g., email, direct messaging, Skype) Q00010[SQ014] Social networks (for example, Facebook, Twitter) Q00010[SQ015] The development of understanding and skills related to the safe and appropriate use of ICT (security settings for Internet browsers, safe websites, network security, harassment, etc.) Q00010[SQ016] Web page creation or editing and multimedia production tools (e.g., media capture and editing, web production) Q00010[SQ017] Installation or modification of operating systems Q00010[SQ018] None, ICT is not worked with the teaching staff in the project Q00010[SQ019] Other
3	Type of ICT devices used by the teachers involved in the Project? (select all that apply)	Q00011[SQ001] Desktop computer Q00011[SQ002] Laptop Q00011[SQ003] Tablet Q00011[SQ004] Paper printer Q00011[SQ005] 3D printer Q00011[SQ006] Scanner Q00011[SQ007] USB memory device Q00011[SQ008] Digital board Q00011[SQ009] E-book reader (for example, Amazon Kindle) Q00011[SQ010] Smart mobile Q00011[SQ011] Virtual reality glasses Q00011[SQ012] None, ICT is not worked with students. Q00011[SQ013] Other
4	What ICT training activities are carried out within the Project? (select all that apply)	Q00012[SQ001] Courses on the use of ICT in teaching given by the educational center or teachers' training center Q00012[SQ002] Training by another teacher who has attended a course on ICT Q00012[SQ003] Observation practices to other teachers who use ICT in their teaching Q00012[SQ004] Participation in online ICT professional learning programs

N.	Questions	
	Question	Options
		Q00012[SQ005] Support participation in professional development on the pedagogical use of ICT
		Q00012[SQ006] None, no ICT training activities are carried out in the project
		Q00012[SQ007] Other

III. MAIN FINDINGS ON THE USE OF ICT BY TEACHERS

The following sections describe the information extracted by the survey.

A. Educational levels most represented in the completed surveys

The educational sectors most represented in the projects analyzed have been Secondary Education (43%) and vocational education and training (36%). Those are followed by university (29%) and adults (20%). These results are in line with the initial distribution of projects, in which the predominant field also corresponded to School Education (Early Childhood Education, Primary Education, Secondary Education and Baccalaureate) followed by Vocational Education and Training (VET) [26, 27].

These educational sectors are also the ones that provide useful information in order to propose them as a model or example of practice on the use of ICT methodologies by teachers for future projects, an objective pursued with this research work.

B. Most used ICT Tools

Today, the use of networks and the processing of digital information increasingly predominate, and it is necessary to have competent teachers capable to train students so as they can discriminate what is fact from what is fiction, as well as being able to use the tools to present and analyze the data they handle in their daily activities.

For this reason, one of the questions that have been considered relevant for the survey has been to know which digital tools are most frequently used by teachers in the Erasmus+ projects analyzed. In Fig. 1 are shown the results obtained from the survey.

The 6 most prominent digital tools used are:

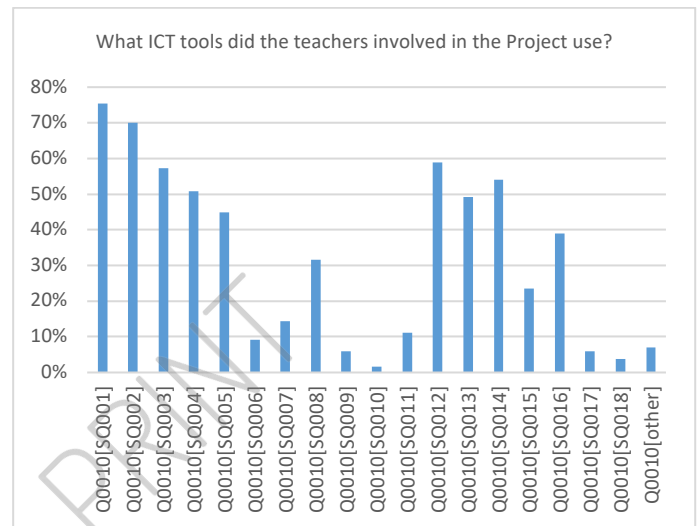
- 1) Basic digital tools (for example, software installation, Internet use, email, word processing, spreadsheets, graphics, file transfers, etc.) (75%).
- 2) Presentations (Prezzy, Genially, Microsoft PowerPoint, LibreOffice Impress, etc.) (70%).
- 3) Collaborate with other teachers via ICT (eg Google Docs, OneNote, Dropbox, vox, Zoho, Padlet) (59%).
- 4) Video and photo software for capture and editing (for example, Windows Movie Maker, iMovie, OpenShot, Edpuzzle, Youtube, Adobe Photoshop, Illustrator, Inkscape, Gimp, etc.) (57%).
- 5) Social networks (for example, Facebook, Twitter) (54%).
- 6) Digital learning environment (e.g. Blackboard, Google Classroom, Moodle, Edmodo, etc.) (51%).

From the data got, the most used ICT tools are those related to office automation management, basic skills and presentations as well as platforms for collaboration. Additionally, stand out those related to video and photo

edition, the use of network resources and digital learning environment.

Those that are used less frequently are those that require a more professional level of knowledge, such as installing or maintenance of operating systems, simulation and modeling software, developing applications or programs or web page creation or editing. This confirms the results detected by ICILS 2013, while most teachers in the study reported using ICT for teaching; this was more common for relatively simple tasks than the complex tasks [14, 15].

Fig. 1. Use of ICT tools by the teachers within Erasmus+ projects



C. Most prominent ICT devices

The second question related to teachers and ICT in the questionnaire has to do with the type of ICT devices that are the most used.

As a teacher it is important to get students to have a good understanding of existing devices and how to use them safely and in an easy way, because, as it is indicated in the paper "Educational projects based on mobile learning", smartphones and tablets are becoming more prevalent, making learning increasingly ubiquitous and more accessible to the average student [36]. Hence is vital to have teachers with the skills needed for using this technology efficiently so they can teach how to use them appropriately to their students.

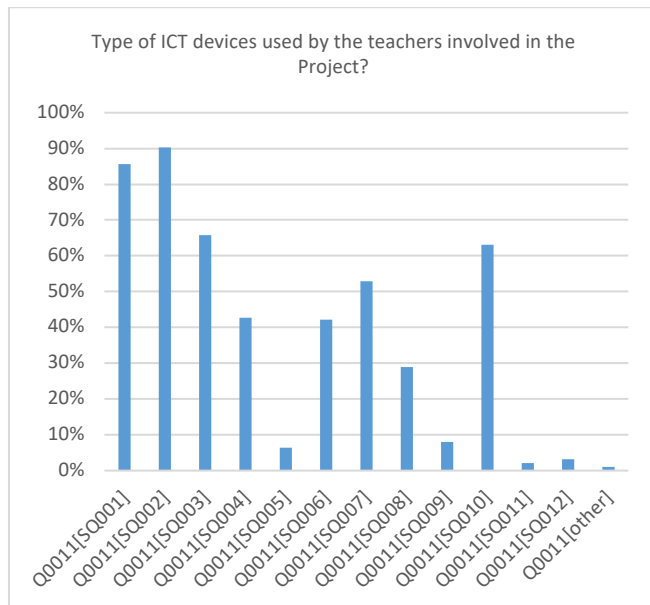
The information related to the use of digital devices provides knowledge about the skills that teachers are developing and using in their teaching practices, and Fig. 2 presents the results.

Within the projects analyzed in this research, the most common devices used within the Erasmus+ projects by teachers, as can be seen in Fig. 2, are:

- 1) Laptop (90%).
- 2) Desktop computer (86%).
- 3) Tablet (66%).
- 4) Smart mobile (63%).
- 5) USB memory device (53%).

The less popular ones are virtual reality glasses, 3D printer and e-book reader, probably because these devices are not so frequent to find in educational centers.

Fig. 2. Use of ICT devices by the students within Erasmus+ projects



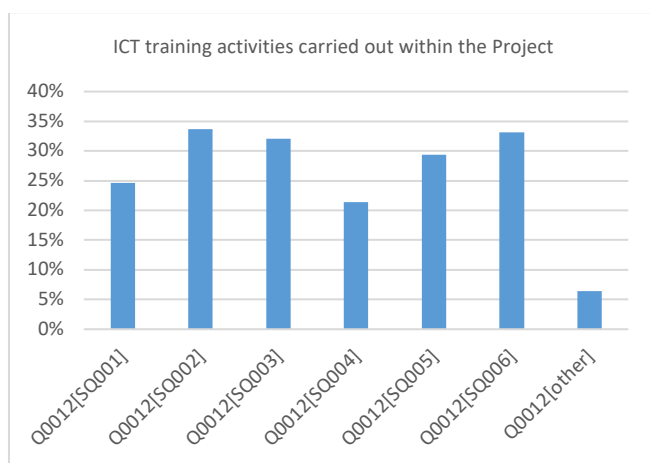
Nevertheless, it highlights that the most used devices are either portable or desktop computers followed by tablets and smart phones, a positive aspect because they are the most used devices in the world of work and teaching about a good use of them will undoubtedly help to have students prepared for their future jobs.

D. ICT training activities

Teacher training is very relevant nowadays because they need to be competent in order to train future workers or improve the skills of current workers so as they are well equipped for the needs of the labor market [1, 10, 16]. For this reason, the fourth question seeks knowing the ICT training activities carried out by teachers.

As regards to the training, the findings are those shown in Fig 3. The most frequent training activities are “Training by another teacher who has attended a course on ICT” (34%) and “Observation practices to other teachers who use ICT in their teaching” (32%).

Fig. 3. ICT training activities for teachers



Surprisingly 33% of the projects that responded to the survey had not carried out teacher training activities. By educational sectors, the data varies between 47% in Higher

Education, 46% in Adult Education, 38% in the VET sector and 20% in the school sector.

E. Differences between educational fields

In previous sections, the global results of the four questions have been analyzed, but it has hardly been assessed whether there are differences in results between educational sectors, an aspect that is interesting since it gives an idea of the trends according to the target audience to which the training is focused. Hence, in this section there is a comparison of the results obtained according to the educational fields of the projects analyzed.

As regards to the educational level it varies depending on the field for which the projects are developed, aspect that is completely normal since the projects are focused on both the students and the teaching staff of the educational sector for which they are working. Although it is observed that they also involve teachers from other educational fields, thus achieving transversal collaboration that enriches the lifelong learning process between them. An example are projects from the VET field in which there are teachers of all sectors involved: 90% of VET, 45% of higher education, 29% of school education and 33% of adults' education.

In relation to the ICT tools used by teachers there are variations between educational fields mainly in higher education in which the percentages are more distributed followed by VET field. Nevertheless, none of the other activities, which have not been pointed out as more common in general, do not particularly stand out.

The use of ICT devices is quite similar among the educational fields, except for the use of USB memory device that is more frequent in school education (73%) than the other fields as well as the digital board (50%), the scanner (60%) and the paper printer (63%).

Finally, regarding the ICT training activities the most prominent differences are the courses on the use of ICT in teaching given by the educational center or teachers' training center and participation in online ICT professional learning programs that are more frequent in the school educational field than in the others.

These differences show a greater activity and involvement in different training activities and using different devices by the school education sector and a greater variety and richness in the use of different ICT resources by VET and higher education. The latter may be due to a more technical training in the case of these educational sectors.

It is interesting to address and analyze better these variations in teacher behavior in the next stage of the research throughout virtual interviews.

IV. CONCLUSIONS

This paper aims at giving an overview of the firsts results obtained in the survey carried out with a group of Erasmus+ projects linked to eLearning and classified as good practice or success story. Specifically, it is focused on one of the main goals of the research related to the use of ICT tools and devices as well as ICT training by the teachers who participated in these projects.

First, it has been analyzed the distribution of teachers by educational sector, the most prominent one is School Education (Early Childhood Education, Primary Education,

Secondary Education and Baccalaureate) followed by Vocational Education and Training, Higher Education and Adult Education. The results are like those obtained regarding the students.

As regards to the ICT tools used by teachers, the frequent ones are those connected with office automation management, basic skills, and presentations as well as platforms for collaboration. Video and photo edition, the use of network resources and digital learning environment also stand out.

Regarding to the ICT devices, both laptops and desktops are the most used, and depending on the educational fields, tablets and smartphones are also very common.

The article analyzes not only the main findings at a global level, but also reflects on how these results vary according to the educational field in which the projects were framed.

It has been detected some differences in teachers' behavior with ICT tools, devices and training depending on the educational field, nevertheless those that stand out globally are also the most frequent in all fields.

The findings got lead to a deeper examination during the next stage of the research, which is focus on an interview phase with some of the surveyed projects. In that phase, the main aim is to gather information that allows us to better understand the reasons for these small variations between educational fields, as well as to deepen the knowledge of the use that has been made of ICT by teachers within the projects and their impact.

In summary, these results serve as support to complete the research [23, 24, 25], obtaining valuable data that could help to guide future educational projects.

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