

Methodological guide for the successful use of digital technologies in education

Improvement of learning through European educational projects

María Goretti Alonso de Castro

Education in the Knowledge Society PhD, GRIAL Research Group, University of Salamanca, 37008 Salamanca, Spain
malonsca@gmail.com

Francisco José García-Peñalvo

GRIAL Research Group, Computer Science Department, Research Institute for Educational Sciences, University of Salamanca, 37008, Salamanca, Spain
fgarcia@usal.es

ABSTRACT

The purpose of this article is to set out the research plan for the doctoral thesis, which deals with the definition of a methodological guide for the successful use of digital technologies in education, especially in eLearning, taking as a reference European educational projects that have been successful in achieving an improvement in the teaching and learning process. We live in an increasingly digital society that requires citizens to be prepared to adapt to the needs of the moment and to solve the problems that arise. For this to be possible, the education system must be prepared to adequately train future citizens who will join a changing labor market. To this end, teachers must be trained and know how to carry out efficient educational projects that allow them to make the most of the potential of ICT in the classroom or in distance education. The situation experienced during the 2019-2020 school year with the COVID-19 pandemic has tested the education system and its ability to adapt to a situation where the use of distance education was required and where ICT was very much needed in most of the cases to bring education to the homes. These factors make it very necessary to work for a better teaching professionalization. Therefore, the main objective of this PhD work is to enable teachers to design their projects, involving electronic learning, in a more effective way. To achieve this, what better than to use the educational projects compiled in the Erasmus+ results platform, which allow the analysis of project typology, outcomes, topics and to see those that have been catalogued as a good practice or success story. This database will be a key tool to gather information together with the collaboration of the main actors of those projects that have been successful. A methodological guide would allow teachers and teacher trainers to know the key factors that help to achieve a good design of educational projects and allow an optimal use of ICT resources and the greatest impact on the teaching-learning process.

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CCS CONCEPTS

• **Applied computing** → Education; Interactive learning environments; Education; E-learning.

KEYWORDS

eLearning, digital technologies in Education, European educational projects, improvement in learning

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1 CONTEXT AND MOTIVATION THAT DRIVES THE DISSERTATION RESEARCH

The increasing use of Information and Communication Technologies (ICTs) in modern society and the need for people to have the necessary skills to participate effectively in a digital world have led to an increase in the use of digital technologies for improving the teaching-learning process.

Besides, the fact that in 2020 the COVID-19 pandemic has broken out, causing the urgent adaptation of our educational centers, teachers, students and families to distance learning methodologies using ICT, has shown the great need we have for progress in technological competence, especially in education.

This situation has been analyzed in many publications as for example Charles Hodge et al. [1] pointed out the differences between a well-planned online learning that create meaningfully experiences from courses offered online in response to a crisis or special situation arisen.

F. J. García-Peñalvo and A. Corell [2] have analyzed digital transformation of teaching and made a reflection of a methodological and competence crisis in higher education on the occasion of COVID-19 pandemic.

In the same line of research F. J. García-Peñalvo et al. [3] proposed a guide of recommendations to help teachers and universities in the evaluation process due to COVID-19, which aim to help a large number of teachers who share this problem at this exceptional time around the planet.

Moreover, H. Fardoun et al. [4] have made a revision of the main difficulties encountered by educational institutions in Iberoamerica

and some strategies used in teaching and learning processes, including the proposal of an assessment model in emergency situations in which contingency plans should be put in place.

These circumstances motivate to promote numerous initiatives developed by various international bodies. Among the bodies involved in researching on electronic learning and TIC in education, it is worth mentioning the following, apart from those already mentioned:

- UNESCO has developed the ICT Competency Framework for Teachers (ICT-CFT) [5] which aims to assist countries in developing comprehensive national standards for ICT competencies for teachers and their inclusion into the school curriculum for the use of ICT in education. Moreover, the resolution adopted by the UNESCO General Conference in 2017 assigns to the UNESCO Institute for Information Technologies in Education (IITE) [6] among its functions research, forecasting, monitoring and reporting on Objective 4 of Agenda 2030 in Education (ODS 4) [7, 8], in which the use of ICT is recognized as a key element [9].
- The International Association for the Evaluation of Educational Achievement (IEA) has developed the International Computer and Information Literacy Study (ICILS) that emphasizes the use of computers as tools for searching, managing and communicating information as key elements of the current digital age, and in its latest cycle, in 2018, has included computational thinking (CT) [10, 11].
- The Organization for Economic Cooperation and Development (OECD) analyses ICT teacher training among other aspects of teacher professionalism, through its study Teaching and Learning International Survey (TALIS) [12] and in the Programme for International Student Assessment (PISA) for 2025 edition will include the innovative domain of Learning in the Digital World which aims to measure students' ability to engage in self-regulated learning while using digital tools [13]. It is also carrying out numerous publications related to ICT and education due to the situation produced by the COVID-19 pandemic.
- At national level, the current Organic Law for the Improvement of Educational Quality (LOMCE) [14] considers ICT to be a transversal competence and it is established a teachers' training network in which there are many activities including eLearning methodologies or learning supported by digital resources and this is not being changed in the new law proposed for present Government, but it will be supported and reinforced. The teachers' training network is composed by the National Institute for Education and Training Technologies (INTEF) [15], with national competencies, and teacher training centers at regional level. In addition, there is training offered by Universities or other recognized organizations.
- The research group GRIAL [16, 17], of the University of Salamanca, is not unaware of these needs and proposes lines of research relating to the link between ICT, the current knowledge society and learning. "Interaction and eLearning" is one of its lines of research, which is the subject of the PhD proposed in this article. They have multiple publications

related to digital technology in education and eLearning. The group also researches aspects related to computational thinking for pre-university studies, as can be seen in a recent publication that analyzes the use of computational thinking and robotics in education [18].

This evidence leads to a great interest on the part of international and national organizations in achieving improvements in learning through ICT, including eLearning. As detected by ICILS 2013, while most teachers in the study reported using ICT for teaching, this was more common for relatively simple tasks than for more complex tasks [10]. For this reason, this PhD work seeks to delve into what projects are being developed in this area and what makes some of them successful or good practice projects by identifying factors that may be useful for future projects.

It is not only a matter of carrying out projects using ICTs, but also that the projects carried out use the maximum potential of technology to improve students' ability to solve problems that they will encounter on a daily basis in their life and work environment. To achieve this, it is necessary to use the appropriate methodology when designing and carrying out the projects, and this is what this thesis seeks to achieve.

In order to explain this PhD thesis plan, this paper presents first the state of the art relative to the purposes of the research, followed by the work hypothesis, the methodology established for the analysis, the main results obtained in this first stage, the current dissertation status and present and future research contributions.

2 STATE-OF-THE-ART

It is necessary to limit the field of research in order to be able to carry out the analysis of projects in an adequate way, hence it has been considered relevant to focus the study on the use of ICT in eLearning, since it is one of the areas in which the efficient use of these technologies is key to achieving success in the improvement of learning, as it is found in [19] there is a great interest in analyzing the possibilities offered by Inclusive Virtual Education, recognizing the diversity of participants found in online courses and it has been emphasized in the need to design and provide accessible educational platforms and resources.

On the other hand, the recent situation due to the COVID-19 has highlighted the need to improve teaching skills in order to be able to tackle properly distant learning in situations where face-to-face teaching is not possible.

This type of teaching also helps all those who cannot participate in face-to-face training to continue their education in a flexible and optimal way, which is a methodology in growing demand. In fact, some studies have been carried out regarding different methodologies that enable a flexible learning as it is the case of:

- Mobile learning in Spain [20], that evidenced its merely instrumental conception, while the still scarce –although apparently growing.
- Blended learning in Peru [21], which also shows the need to optimize the use of this methodology to achieve a more autonomous training, for a gradual insertion into the professional world.
- Joint Programmes and Degrees [22], which increase the mobility of students and teachers who often spend periods of

study in the different participating institutions and facilitate opportunities for cooperation and mutual learning between institutions.

- The use of smartphones and its impact on attention [23], in spite of many unresolved questions on the effects of smartphone usage on different attentional domains, the smartphone usage could have beneficial effects on certain processes of attention.
- Interactive learning environments [24] that are able to give a more flexible and learning approach strengthening the learners control and their learning process providing services, tools, people and resources.

As far as eLearning is concerned the GRIAL group has produced numerous publications related to eLearning, most notably the articles [25–28] in which the current state and advances in eLearning are analyzed, as well as the trends for the future of this teaching-learning methodology.

UNESCO has analyzed the effectiveness of eLearning [29] and it is concluded that, as long as eLearning is treated as a means for teaching, it can make a big difference in the outcomes. However, it points out that achieving an improvement in the outcomes depends on the type of eLearning and the use made of it. UNESCO's continued contribution in this area could be of crucial importance.

Moreover, in ICILS 2013 it was showed that schools and classrooms vary in the extent to which educators use ICT for teaching.

Although eLearning technologies are widely perceived as a means of producing transformative effects in classrooms, their implementation has been relatively limited and the effectiveness of ICTs in promoting learning appears to depend on practices and their ability to integrate digital technologies into teaching practice [10, 11].

In addition, CEDEFOP, in the information note [30], finds the need for lifelong learning to adapt to the needs of the labor market with the help of a combination of electronic resources and face-to-face interaction between student and teacher so that it is possible to adapt to the context of the users and the time available to them.

In the same vein, the book [31], regarding UNESCO and lifelong learning, sheds light on the overall impact of the objectives that the institution promotes and in what way they influence lifelong learning, which is constantly changing throughout the world, including eLearning.

Furthermore, the OECD has been publishing different reports with information gathered from TALIS, PISA and Education at a Glance studies, in relation with teacher and student's digital equipment and competencies, as well as school resources on the occasion of the recent covid-19 pandemic.

One of the main results of this work has been the country notes that explains the main findings for OCDE countries [32]. These country notes reflect level of preparedness of educational systems detected by the data gathered through the referred studies in the field of ICT in education, among others, and allow us to review the aspects that require implementation of improvements in this field.

Additionally, the European Union (EU) also encourages the implementation of ICT-based projects, such as in the European education project Programmes. In the case of Erasmus+, ICTs are one of the priorities and topics considered for the funding of projects.

In the Erasmus+ Project Results Platform [33], which contains all the projects funded by the Erasmus+ Programme and its predecessor programmes in education, youth and sports since 2007, we find more than 20,000 projects related to eLearning or ICT. These projects are classified and allow for the selection of those that are labelled as good practices or success stories [34].

All these analyses and publications support the need to continue improving educational projects involving ICT, including eLearning projects, which are the purpose of the doctoral work plan presented here.

3 HYPOTHESIS/THESIS AND/OR PROBLEM STATEMENT

The main objective of this thesis is to create a methodological guide for the implementation of successful projects based on digital technologies in education or eLearning in order to achieve improvement in learning, curricular diversification and a clear impact on the teaching-learning process through the use of technology in education.

A fundamental idea developed in recent eLearning literature is that it is transforming the education sector in a very innovative way. The multiplication of courses and the radical change in the education sector give students a great opportunity to decide their career according to their competences and skills. And this is beneficial not only for students, but also for institutions, such as educational centers and bodies, corporate structures and nations [29].

Nevertheless, using technology is not enough, it needs to be used appropriately and have a real impact on improving learning [29]. It is not only about motivating learning with attractive digital tools, but also about achieving progress in students' problem-solving skills through the use of these tools.

In fact, ICILS 2013 showed that while most teachers reported using ICT for teaching, this was more common for relatively simple tasks than more complex tasks [10, 11].

Therefore, creating a methodological guide, based on educational projects considered as good practices or success stories in this field, will allow establishing a framework with guidelines to be considered in the development of educational projects in digital technologies in education and eLearning.

To achieve this goal the database of Erasmus+ projects could be a key source of information for shaping the methodological guide based on real projects that have been carried out and for which there is documented information.

4 RESEARCH OBJECTIVES/GOALS

The initial objective set for this thesis is subdivided into a series of sub-objectives:

- Examine in depth the potential of eLearning and digital technologies in education in different educational areas through the European projects of the Erasmus+ Programme in the 2014-2020 cycle.
- Review the evolution and scope that have been covered through Erasmus+ projects of digital technologies in education in 2014-2020 cycle to the present time, especially focusing on those listed as good practices or success stories.

- Analyze the aspects that have ensured that the European projects developed in this area have been considered good practices or success stories.
- Study what impact is detected through assessment procedures of digital competence in relation to digital technologies in education.
- As a result of the above, how to get the most out of digital technologies for the future and to be able to extrapolate the success factors identified to other projects, generating a guide or model of action that allows the design of projects that take advantage of the maximum potential of technology and have a real impact on the improvement of teaching-learning processes.

In short, the thesis presented here seeks to generate a model based on the outcomes and institutions of successful projects, trying to resolve issues such as:

- why they were considered good practice,
- what impact they had on schools, their students and teachers,
- how they measured that impact, whether they are still applied today,
- whether they have been transferred to other educational environments and the outcomes they have had there,
- what support they have in order to carry out the project,
- what resources are needed to carry them out, what aspects they consider needing revision over time in order to adapt them to the changes taking place or to the environment in which they are applied and,
- on this basis, what changes they have made to ensure that they continue to be carried out at present and are useful for the educational system in which they are applied.

In conclusion, the final aim of the thesis is to generate a methodological guide to guide the implementation of efficient educational projects with eLearning and digital technologies in education, providing maximum performance and achieving a significant impact on the teaching-learning activities for which they are used.

5 YOUR RESEARCH APPROACH AND METHODS, INCLUDING RELEVANT RATIONALE

This PhD will be developed using a mixed methodology that combines both quantitative and qualitative analysis [35], since this type of research is not only about collecting qualitative data from interviews or collecting multiple forms of qualitative evidence (e.g., observations and interviews) or multiple types of quantitative evidence (e.g., surveys and diagnostic tests), but involves intentionally collecting both quantitative and qualitative data and combining the strengths of each to answer research questions [36]. In order to achieve this, the guidelines for systematic reviews of research projects will be used as a reference [37, 38].

On the one hand, we will try to assess quantitatively how common factors have influenced the success of different Erasmus+ educational projects with eLearning and ICT, and on the other hand we will analyze qualitatively how the implementation, outcomes and sustainability of these projects can help to define guidelines for achieving good quality in future projects.

The work is being implemented in three distinct phases. Firstly, a detailed study of the state of the art from an academic point of view has been carried out.

Secondly, a study of Erasmus+ eLearning or ICT projects is under way, seeking to obtain a model that reflects the key factors for successful projects, catalogued as good practices or success stories.

Thirdly, a quantitative analysis will be carried out first, based on a survey, and then a qualitative analysis, through interviews, with the aim of developing the methodological proposal to achieve educational projects with a real impact on the teaching-learning process, which will allow to exploit all the possibilities that technology can provide in this process.

These phases are described below:

- **Prior analysis of the state of the art:** the first step has been the analysis of information sources in order to gather information on previous studies carried out on the use of eLearning and digital technologies in education, following a systematic procedure with the guidelines proposed in [37, 38].
- **Review the indicators or variables to be analyzed:** European educational projects of the Erasmus+ Programme (2014-2020) related to eLearning and digital technologies in education that have been catalogued as good practices or success stories are being analyzed, examining the common variables and indicators that can be key to the analysis of the aspects that make a great impact on the results obtained by them.
- **Sample selection:** the target population, in August of 2020, is more than 1000 European educational projects from the Erasmus+ Programme (2014-2020), related to eLearning and more than 2200 with ICT classified as good practice and/or success story. It is necessary to carry out research on a sufficiently significant sample in order to be able to extract generalizable data to generate manuals of good practices useful for taking advantage of the maximum potential of technologies to achieve good results in teaching-learning processes. Therefore, a sufficiently large sample of approximately 1000 projects will be chosen at the first stage.
- **Method of data collection:** for the data collection three phases will be carried out:
 - First the information will be extracted from the Erasmus+ project database from which the following variables can be analyzed: type of project, title of the project, year of start of the project, duration, project topics, project summary, coordinating country, participating countries and project results.
 - The second phase for data collection will consist in the creation of an online digital form to collect information about the project coordinators in relation to the success of their projects, in order to allow the collection of the information in a simple way and also to facilitate its later analysis. Doing it through an online form facilitates the sending of the form through the different channels indicated: email, networks, educational platforms, etc.
 - The third phase will consist of conducting telephone or Skype interviews with a minimum of 10% of the coordinators

to obtain a more personalized assessment of their perception of the project's success and sustainability, so that we can have worthy information. It also facilitates further analysis of the data with statistical analysis tools such as SPSS or R.

- **Data analysis:** as a result of data collection, spreadsheets with the results will be obtained, as well as results analysis graphs related to the variables or indicators. The methodology of analysis will be qualitative from the point of view of the analysis of the projects registered in the database of the platform of results of Erasmus+ and of the evaluations obtained through the interviews made to the coordinators. In addition, the quantitative methodology will be applied in order to analyze the results obtained through the survey carried out to obtain the assessment of the results and sustainability of the projects by their coordinators and/or partners.
- **Report with the conclusions:** a report will be made with the conclusions reached after the analysis of data and the detection of success factors that can have an impact on the improvement of the teaching-learning processes, disseminating these through the thesis and articles in educational research journals.

Regarding the ethical-legal considerations, the conduct of this work will follow the ethical guidelines and principles for research as set out in the Declaration of Helsinki adopted at the World Medical Association (WMA) Assembly in 1964, and in the latest update in 2004.

6 RESULTS TO DATE AND THEIR VALIDITY

The PhD project is starting, the project plan has been recently approved, and so far, an analysis of related documentation has been carried out, as well as an analysis of the types of projects that can be found in the Erasmus+ results platform so that the sample for the study can be properly chosen.

In particular, the following preliminary results can be detailed below:

- 7% of Erasmus+ projects are related to eLearning (more than 9400 projects out of more than 134 500 Erasmus+ projects in August 2020) of which the 11% have been labelled as good practice or success story.
- Spanish educational institutions are the second most active in this type of projects, with more than 3200 projects following Italian institutions with more than 3400 and have achieved the greatest number of good practice projects or success stories at the time of writing this article.
- The Erasmus+ actions with the highest number of projects related to eLearning are KA1 and KA2, highlighting all those in the school sector that include infant, primary, secondary and high school studies and followed by Youth and Vocational Education and Training fields.
- The two main topics in which are focused the Erasmus+ projects related to eLearning are: "New innovative curricula/educational methods/development of training courses" and "ICT - new technologies - digital competences".
- If, in addition to the projects linked to e-Learning, we observe projects associated to other related methodologies such as

m-Learning, a methodology to which has been devoted many research actions in recent years and which can bring great benefits [39], b-learning, u-learning, etc., we find that there are less projects in the database. In the case of m-Learning only appear referred in 2.5% of Erasmus+ projects, therefore there is a less representative percentage of references than in e-Learning.

These main findings give us a glimpse of the possibilities that the aforementioned Erasmus+ project database can offer and consider them as positive in terms of having enough data in order to undertake the research successfully. More detail on this information will be published in another article.

It is important to take into consideration that all these data may vary somewhat over time since the projects on the Erasmus+ results platform increase day by day as they are being finalized, or because new projects are included.

However, considering that in 2014-2020 cycle all projects from 2014 to 2017 are already closed, and some of the subsequent years, which represent 60% of all projects, we could consider that there will be no significant changes in the percentages.

Hence, it is necessary to consider this circumstance of constant change and in view of the doctoral work it will be necessary to establish as a basis the projects of a specific moment in time, even if there is an update afterwards.

7 DISSERTATION STATUS

Presently the selection process of projects for sampling is under way, as well as gathering all the main information that can be exported from the Erasmus+ results platform.

Once the selection of the sample is closed, the contact details of the project coordinators will be collected in order to contact them for the subsequent stages for the survey and/or interview. At the same time, it will be necessary to review the project summaries, as well as their outcomes the get all the information of interest.

8 CURRENT AND EXPECTED CONTRIBUTIONS

This work is being developed in the Doctorate program Training in the Knowledge Society [40–42] and its portal will be the main tool for communication and visibility of its progress [43, 44]. Besides, as this thesis is being carried out in the GRIAL Group of the University of Salamanca [16, 17] all the outcomes will be accessible openly [44–46].

In addition, for the development of the thesis there would be of great value to be in contact with colleagues in the field of education and European projects, as well as reviewing resources and publications related with education, e-Learning and ICT in the Educational Administration both at the level of European programs and educational assessments.

The different stages proposed in the methodology are being implemented sequentially, covering a period of 36 months, that started in 2019-2020 academic year with the design of the research plan.

At the end of each stage, a milestone is set with a series of results that will allow to continue to the next phase. The main

milestones planned for delivery over the next two academic years are as follows:

- Review of the literature and compilation of information on the projects of the Erasmus+ results platform.
- First phase of quantitative research, with compilation of information on the keys to success of European eLearning and ICT projects by means of a digital survey.
- Second phase of qualitative research with collection of information on the success factors of the European eLearning and ICT projects through telephone, Skype or virtual interviews.
- Memory of PhD.

Throughout the entire process, it is proposed to carry out a plan to disseminate the progress that is made in each of the phases described above.

9 CONCLUSIONS

The aim of the PhD work, presented on this paper, is to enable teachers to design their projects, involving electronic learning, in a more effective way.

In order to be able to provide a useful guide for teachers the educational projects, compiled in the Erasmus+ results platform, are being analyzed. This allows an analysis of project typology, outcomes, topics and to see those that have been catalogued as a good practice or success story. This database is the main tool for gathering information together with the collaboration of the main actors of those projects that have been successful.

The guidelines for systematic reviews of research projects will be used as a reference [37, 38] for analyzing the projects.

At this stage the selection process of projects for sampling is under way, compiling the main information that can be found on the Erasmus+ results platform as well.

At the end of 2020, with the contact details of the project coordinators collected from the platform and their websites, a survey and/or interview will be designed. At the same time, it will be necessary to review the project summaries, as well as their outcomes to get all the information of interest.

As a result, a methodological guide would be provided. This guide would allow teachers and teacher trainers to know the key factors that help to achieve a good design of educational projects and allow an optimal use of ICT resources and the greatest impact on the teaching-learning process.

Finally, there will be several publications and communications throughout the research period under the umbrella of the GRIAL Group of the University of Salamanca [16, 17] and all the outcomes will be accessible openly [47].

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