The competence of digital entrepreneurship in education: Analysis of the perception of university students

María del Mar Sánchez-Vera [iD], Patricia López-Vicent* [iD]

Universidad de Murcia (Spain)

mmarsanchez@um.es
Corresponding author: patlopez@um.es

Abstract

Purpose: From an educational perspective, digital entrepreneurship comprises the convergence of the dimensions of entrepreneurship competence and digital competence. The EmDigital project has generated a model of digital entrepreneurship based on the proposals of Entrecomp and Digcom models that, from a transversal approach, addresses digital entrepreneurship from the perspective of challenges and the development of new opportunities that technology can offer.

Design/methodology/approach: The project conducted a study using a non-experimental and exploratory design with the objective of analyzing the digital entrepreneurship competence of 135 final-year students from the Polytechnic University of Cartagena. A questionnaire validated by experts and exploratory factor analysis was used to assess the four dimensions of digital entrepreneurship competence: identification of opportunities, action planning, implementation and collaboration, and management and security.

Findings: The results show that the students feel they are more competent in the dimension of management and security, while they perceive that the dimension related to the identification of opportunities in the framework of digital entrepreneurship is less developed. It is concluded that it is necessary to establish a series of common and interdisciplinary indicators around digital entrepreneurship that can be reinforced in all degrees, so students could develop good strategies related to digital entrepreneurship regardless of the degree they come from.

Originality/value: The added value of this study lies in its comprehensive approach, the solid theoretical foundation on which it is based, its exploratory approach, the integration of key dimensions, the identification of specific areas of improvement and the practical recommendations to address these deficiencies in higher education.

Keywords: Digital competence, Education, Professional development, Entrepreneurship, Higher level education

Jel Codes: I21

To cite this article:

1. Introduction

This article presents an analysis of the digital entrepreneurship competence of final year undergraduate students at Polytechnic University of Cartagena. This work is part of a project based on a theoretical model that links entrepreneurship competence with digital competence, in order to establish new opportunities for the analysis and improvement of the development of these skills.

This project addresses the conjunction of both skills: entrepreneurship and digital. If the COVID-19 pandemic has highlighted anything, it is the importance of being able to find entrepreneurial solutions in digital contexts (Bosma, Hill, Ionescu-Somers, Kelley, Guerrero & Schott, 2021). Technology has enabled the development of digital artifacts, platforms and infrastructure, which has influenced the conceptualization of entrepreneurship (Nambisan, 2017). In fact, around digital entrepreneurship there has also been a transformation in recent years, finding an increasingly interdisciplinary approach (Zaheer, Breyer & Dumay, 2019).

Just like entrepreneurial competence does not only refer to creating a business and digital competence is not only related to the technical handling of tools, digital entrepreneurship also refers to the approach of new challenges and the development of new opportunities that technology can offer (Román & González, 2022).

Digital entrepreneurship is a complex and dynamic phenomenon that requires a multidisciplinary approach to understand and foster its development. This multidisciplinary approach allows for a more comprehensive understanding of the challenges and opportunities presented by technology in the context of entrepreneurship (Mavlutova, Lesinskis, Liogys & Hermanos, 2020). Digital entrepreneurship has been studied in other fields, such as business and technology, and it is important that education also can takes an active role in shaping future digital entrepreneurs by providing them with a solid foundation in digital and entrepreneurial competencies. This digital entrepreneurship competence must be worked within the classrooms in higher education institutions, to train future professionals and capable citizens in a digitalized society (Prendes, 2022). Therefore, it is essential an approach to support the development of multidimensional cognitive and emotional competences and behavioral outcomes to enable entrepreneurial value creating activity across a range of contexts (Mawson, Casulli & Simmons, 2023).

The project "Skills for digital entrepreneurship of university students" (https://www.um.es/emdigital/) is a project funded by the Séneca Foundation (Science and Technology Agency of the Region of Murcia) with the aim of training university students in the digital entrepreneurship competition.

The four main objectives of the project are:

- To analyze the digital entrepreneurship skills of students in the final year of their degree at public universities in the Region of Murcia.
- To know the keys to success of digital entrepreneurs based on the analysis of the skills and strategies that they implement for the realization and effective achievement of their business projects.
- To design, implement and evaluate a training plan aimed at developing entrepreneurship and digital skills in undergraduate university students.
- To develop a digital entrepreneurship model around which institutional, training and personal recommendations related to improvement processes for the professional development of our university graduates can be articulated.

One of the first phases of work on the project was to define a digital entrepreneurship model. For this, a documentary analysis and a focus group that analyzed the areas and indicators of entrepreneurial skills and digital competence proposed by the European Union (2019) were carried out. Subsequently, the pilot model was validated through expert judgment and finally defined with another focus group. The proposed digital entrepreneurship competency (Figure 1) includes four areas, 15 sub dimensions, and 45 indicators (Prendes, Solano & García, 2021).

In a second phase, the EmDigital project has applied a questionnaire to students in the last year of their degree in different branches of knowledge at the University of Murcia and the Polytechnic University of Cartagena.
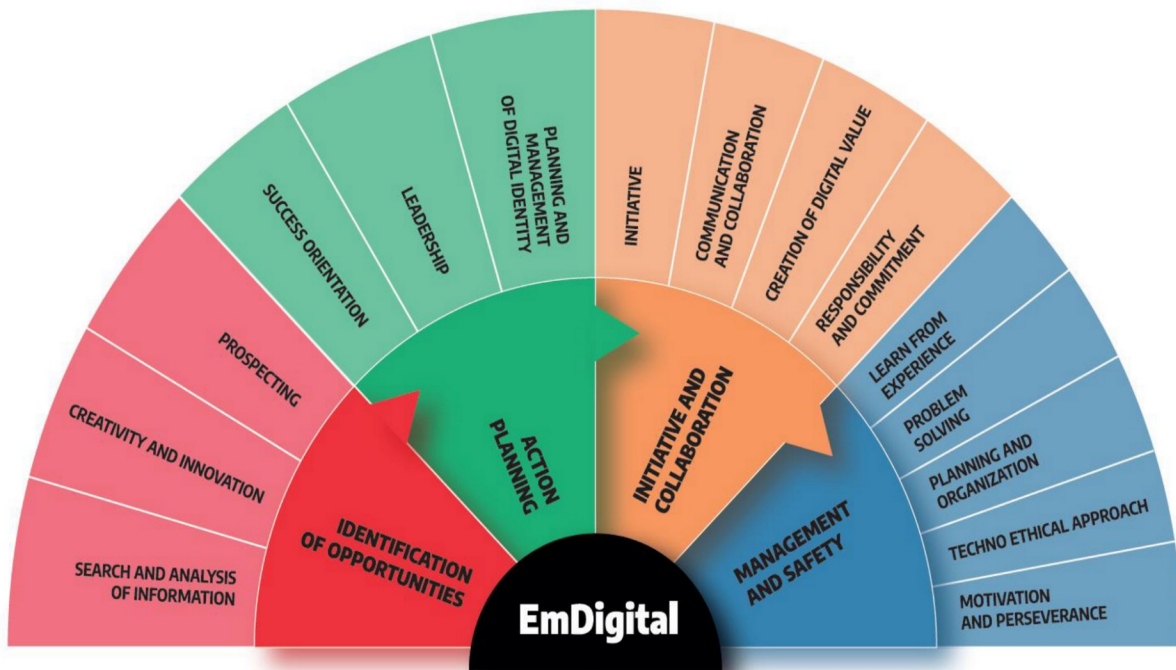
Figure 1. Emdigital model

The purpose of this phase was to "conduct an analysis of the needs of students at public universities in the Region of Murcia in terms of digital entrepreneurship" (González, Prendes & Solano, 2022). Once the results were obtained, a MOOC (Massive Open Online Course) online course was designed with the idea of improving the digital entrepreneurship competence of university students.

The research gap addressed by this work is the need for a comprehensive understanding of digital entrepreneurship competencies among university students, especially in the context of blending entrepreneurial and digital skills. The study explores the convergence of these competencies in the educational sector, a relatively underexplored area.

The main theoretical contributions of this work include the development of a digital entrepreneurship model based on the integration of Entrecomp and Digcom frameworks. This model facilitates a transdisciplinary approach to understanding and fostering digital entrepreneurship competencies. It also offers insights into how these competencies vary among students from different academic backgrounds and between genders.

This article presents the results found in terms of the analysis of the questionnaires applied in the Polytechnic University of Cartagena and its aim is to answer the following questions: What is the profile of the final year students in terms of the development of the digital entrepreneurship competence? What is the perception of these students in relation to the identification of opportunities to develop? Do the students feel capable of planning a digital entrepreneurship action? Do they know the processes to implement and collaborate? Do they feel capable of managing and providing security to the process of digital entrepreneurship? Are there differences regarding gender and academic degree?

First of all, the article presents a review of the competence of digital entrepreneurship in education. Secondly, the study methodology, objectives, hypotheses, participants and information collection instrument are described. Thirdly, the results are shown depending on the dimensions of the study. Finally, the discussion and conclusions of the work are presented.

2. State of the Art: The Competence of Digital Entrepreneurship in Education

In 2006, the European Union established a series of basic competences for lifelong learning: Communication in the mother tongue; Communication in foreign languages; Mathematical competence and basic competences in

science and technology; digital competence; learning to learn; Social and civic competences; Sense of initiative and entrepreneurship; and Cultural awareness and expression.

In the first definition of entrepreneurial competence by the European Union, the competence of initiative and entrepreneurship was defined as the ability to convert ideas into actions (European Union, 2006). Since then, the entrepreneurship competence has had an impact on different countries, although there is a lack of shared vision on how to develop it (Seikkula, Salomaa, Jónsdóttir, McCallum & Israel, 2021). Some approaches on how to introduce entrepreneurship in education have been questioned, as they are considered to have an excessively business-focused approach, forgetting the pedagogical potential it presents from an educational perspective (Mason & Arshed, 2013).

Two perspectives can be identified around entrepreneurship: the one related to the process of creating and managing a company, and the one that proposes the development of solutions to social problems and the acknowledgement and development of a person's worth through entrepreneurial attitudes (Lilleväli & Task, 2017). In this sense, Lisetchi and Brancu (2021) also noted this debate between the economic and the social components, as if they were two unrelated concepts.

Therefore, one of the potentials of the development of entrepreneurial competence is the improvement of the job prospects of young people (Premand, Broadmann, Almeida, Grun & Barouni, 2016). But we must also appreciate that the concept of entrepreneurship goes beyond the business context to conclude that the development of this competence also allows the implementation of a series of skills of interest to any citizen and in different personal and professional contexts (Prendes & García, 2020). In this sense, some concepts are included, such as social entrepreneurship, which would be considered an innovation in itself, since it fosters a change in a context and influences a social environment (Lisetichi & Brancu, 2021).

Sam & van der Sijde (2014) reflect on the concept of entrepreneurship in the university environment, specifically that of the University as an entrepreneurial institution. For them, there are many visions around what it means for an institution to promote entrepreneurship. Universities have to adjust and respond to business changes, but they also have a social and cultural mission and are agents of change in this regard.

Studies carried out on the development of entrepreneurial ability in higher education students indicate that the profile of students who present greater entrepreneurial competence is that of an athletic man who combines studies with paid work and who accesses university studies through the itinerary of Vocational Training (Vall-Llosera, Repart, Saurina & Serra, 2022). However, another study conducted by Tejeiro, Molina and García (2021) indicates that it is especially relevant to find parity between men and women when it comes to entrepreneurship, since otherwise, inclusive development would not be achieved, nor would all the entrepreneurial potential of a society be exploited.

Returning to that broad perspective of entrepreneurship, educational experiences around it have been evolving, going from focusing on experiences on how to start a new business in its origins, to later moving on to proposing broader visions on how to identify opportunities and manage digital environments (Ratten & Usmanij, 2021). In 2016, the European Commission developed the EntreComp framework (the entrepreneurship competition) (Figure 2), considering it as a competence with a transversal approach that allows personal development and participation in society. Entrepreneurship in this way acquires a commercial dimension, but also a social and cultural one (Bacigalupo, Kampylis, Punie & Van den Brande, 2016). It incorporates several dimensions, organized into broad areas: ideas and opportunities, resources and into action.

Among the key competences, we also find Digital Competence, understood as a basic aspect in the development of citizens of the 21st century in the current digital world. The DigComp model was published for the first time in 2013 to establish a reference framework in Europe with the idea of determining what skills are necessary today to use technology effectively, collaboratively and creatively for different purposes and to promote inclusion in the digital society (Kluzer & Pujol, 2018).

The Digcomp model has several levels of development organized by areas and sub competencies (Carretero-Gomez, Vuorikari & Punie, 2017). This model has influenced how to understand and approach the integration of digital competence in several countries at the educational level (Zhao, Pinto & Sánchez, 2021). We

can indicate that digital competence has been made a key part of education and from there it is approached from a triple perspective: the digital competence of students, the digital competence of teachers, and the digital competence of institutions, with the development of the education centers' digital plans. In the educational field, digital competence has also been approached depending on whether this concept is defined from politics, research or both contexts (Spante, Sofkova, Lundin, Algers & Wang, 2018).
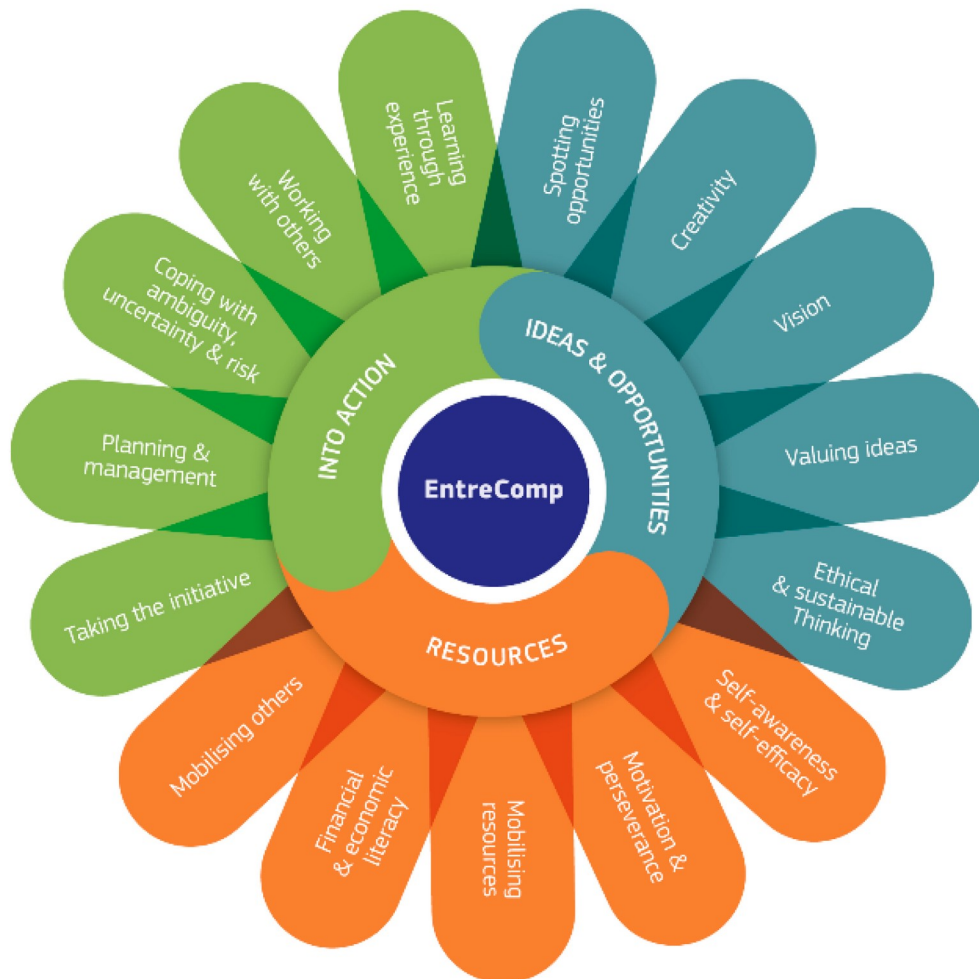

Figure 2. Entrecomp model. (McCallum, Weicht, McMullan & Price, 2020).

Regarding digital teaching competence, a popular model is the TPACK model by Mishra and Koehler (2006), which establishes the three knowledge and dimensions that a teacher must address to teach through technology: content, pedagogical and technological knowledge. This model has been completed with other contributions, such as that of Prendes, Gutiérrez and Martínez (2018), who suggest five dimensions for digital teaching competence (technical, informational/communicative, educational, analytical and socio-ethical), which take place in three areas of application (teaching, research and management).

To address the digital competence of students, Esteve and Gisbert (2013) take the DigComp framework as a reference and specify that "digital competence, therefore, is the sum of all these skills, knowledge and attitudes, in technological, informational, multimedia and communicative aspects, giving rise to a complex multiple literacy" (Esteve & Gisbert, 2013: p. 55).

In any case, digital competence goes beyond learning how to use digital tools at a technical level and establishes a series of dimensions and sub-competencies, as can be seen in Table 1.

Competence Areas	Competence
1. Information and data literacy	1. Browsing, searching and filtering data, information and digital content 2. Evaluating data, information and digital content 3. Managing data, information and digital content
2. Communication and collaboration	1. Interacting through digital technologies 2. Sharing through digital technologies 3. Engaging in citizenship through digital technologies 4. Collaborating through digital technologies 5. Netiquette 6. Managing digital identity
3. Digital content creation	1. Developing digital content 2. Integrating and re-elaborating digital content 3. Copyright and licenses 4. Programming
4. Safety	1. Protecting devices 2. Protecting personal data and privacy 3. Protecting health and well-being 4. Protecting the environment
5. Problem solving	1. Solving technical problems 2. Identifying needs and technological responses 3. Creatively using digital technologies 4. Identifying digital competence gaps

Table 1. Digcomp competence areas and competences (Kluzer & Pujol, 2018: p. 12)

3. Methodology

The article describes a study that aims to analyze the digital entrepreneurship competence of undergraduate students in their last year at the Polytechnic University of Cartagena.

The objectives of this work are: (a) to identify the profile of final-year students in terms of their digital entrepreneurship competence development; (b) to analyze students' knowledge of the processes for implementing and collaborating in digital entrepreneurship; and (c) to identify possible differences in terms of gender and degree in relation to final-year students' digital entrepreneurship competences and perceptions.

In this context, the following hypotheses are considered:

1. (H_0): There are no significant differences in the perception of digital entrepreneurship competencies between genders.

    (H_a): There are significant differences in the perception of digital entrepreneurship competencies between genders.

2. (H_0): There are no significant differences in digital entrepreneurship competencies among students from different areas of knowledge.

    (H_a): There are significant differences in digital entrepreneurship competencies among students from different areas of knowledge.

The Polytechnic University of Cartagena was selected for this study because it represented a unique case among the three universities participating in the project, being the only polytechnic university. This distinction made it a particularly interesting case to study in its own right. Polytechnic universities typically have a strong focus on engineering and technology disciplines, which can offer distinct insights into digital entrepreneurship competencies. Moreover, the inclusion of Social and Legal Sciences broadens the scope of the study to encompass non-technical disciplines. This combination offers a great opportunity to explore digital entrepreneurship competencies across a spectrum of academic disciplines within a single institution, especially one with a polytechnic orientation.

For this purpose, to contrast the hypotheses, a stratified random cluster sampling was carried out, using the two fields of knowledge that the university has (Engineering and Architecture, and Social Sciences) as the strata. The representative sample was established and the questionnaire was applied in the final year of the university's degree programs, both in person and online. In areas with limited existing research, exploratory studies are important as they help in uncovering initial trends and patterns, which are essential for forming an understanding of the topic. These surveys are valuable for generating hypotheses in new or less understood fields, providing a basis for more in-depth future research.

The data analysis included a descriptive part in relation to the digital entrepreneurship competence model and also a descriptive univariate analysis of each dimension and of the sub-dimensions in relation to variables such as branch of study and gender.

3.1. Participants

The population of this study equals the total number of students enrolled in the last year of the Polytechnic University of Cartagena. A random sampling stratified by conglomerate was carried out. In the case of the Polytechnic University of Cartagena, the two branches of knowledge were used (Engineering and Architecture, which had a total of 3,778 students in the last year of the degree; and Social and Legal Sciences, also with a total of 567 students in the fourth year of the degree) as the strata for carrying out the distribution. Cluster random sampling has been chosen to ensure a fair representation of the different groups or strata of the student population. This type of sampling also ensures that all subgroups of the population are represented according to their realistic size in the population. The degrees of these branches and the last year of Degree were the clusters. With a confidence level of 95% and a sampling error of 0.03, a necessary sample of 18.31 students of Social and Legal Sciences and 122.03 students for the Engineering and Architecture branch was established. This way, we opted for having a representative sample of participants, chosen intentionally, and a total of 135 questionnaires were collected.

In relation to said sample, we observe that 73.3% are men and 26.7% are women, whose ages are between 20 and 35 years, with the average age being 22.9 years. 88.9% of the sample of participating students belonged to the Engineering and Architecture branch and 11.1% to the Social and Legal Sciences branch. Although the representation of women may seem low, it is important to consider that some subpopulations may have a lower numerical representation. The proportion of women in these Engineering degrees, for example, is usually low, 25.1% according to the Ministry of Universities (Ministerio de Universidades, 2021), so the sample collected would be in accordance with this reality.

3.2. Instrument

This study has been based on a non-experimental and exploratory design, using the survey as an information collection technique and, within it, a questionnaire that has allowed to obtain the data of said investigation.

This questionnaire was designed and validated within the framework of the EmDigital project in order to collect information on the digital entrepreneurship skills of the students of the Polytechnic University of Cartagena.

The questionnaire was validated through expert judgment and exploratory factor analysis with a pilot sample of 190 final year undergraduate students. This research is part of a larger study involving other institutions, so a sample from a variety of degrees and institutions was considered for the piloting.

The AFE results showed 4 factors that explain 43% of the variance (González et al., 2022). The questionnaire is organized into various blocks, which are articulated around the previously explained EmDigital model.

The questionnaire consists of 55 items with 5 response options in which 1 corresponds to "*totally agree*" and 5 to "*totally disagree*". The 55 items are distributed among the four dimensions that make up the model described. Thus, 8 items make up the *identification of opportunities* dimension, 11 items *action planning*, 15 *implementation and collaboration*, and 21 *management and security*. The final version of the questionnaire can be consulted at https://digitum.um.es/digitum/bitstream/10201/110187/1/cuestionarioEMDIGITAL.pdf.

4. Findings

The results are presented according to the dimensions of the research through which it is intended to analyze the digital entrepreneurship competence of the students in the last year of the degree of the Polytechnic University of Cartagena, as well as to know the keys to the success of digital entrepreneurs from the analysis of the competences and strategies that they implement for the realization and effective achievement of their business projects.

As shown in Figure 3, the results obtained about the dimensions indicate that the students feel more competent in management and security (80%), followed by initiative and collaboration (55%) and planning of the action (42%), while the dimension of entrepreneurship that is considered less competent is the identification of opportunities (30%).
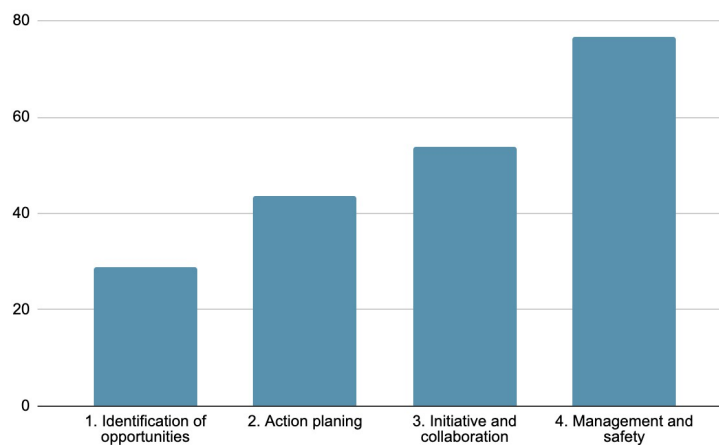

Figure 3. Emdigital model dimension scores

The results presented in Figure 3 refer to the assessment of digital entrepreneurship competence of students in their final year of undergraduate studies at the Polytechnic University of Cartagena. These results are structured according to different key dimensions to understand the skills and capabilities that students possess in the field of digital entrepreneurship, as well as to identify the success factors of digital entrepreneurs through the analysis of the competences and strategies they implement in the realization and effective achievement of their projects. Taking this into account, the percentages of each of the variables analyzed are presented after the univariate descriptive analysis performed on each dimension, as well as the significant differences found in the sub dimensions with regard to variables such as the branch of study and gender.

4.1. Identification of Opportunities

The items that make up the dimension have a mean of 28.9, which is distributed among the three sub dimensions that make it up (information search and analysis, with 14.4; *prospecting*, with 7.86; *creativity* and *innovation*, with 6.63).

Regarding this dimension, the majority of the students neither agree or disagree regarding questions, as we found the responses to be located in the middle range of responses, such as knowing how they can contribute with their ideas to promote online entrepreneurial initiatives (38.5%), feeling capable of determining whether it is feasible to develop and implement the ideas they have in the immediate future (36.8%), feeling capable of proposing innovative ideas that have a practical application (35.6%), recognizing in oneself innovative ideas that could materialize in digital entrepreneurship projects in the future (33.8%) or feeling capable of using digital technologies to look for opportunities for business (31.9%). In addition, 34.1% of students state that they feel indifferent, but also agree when asked if they feel capable of undertaking a network project based on needs that they themselves identify.

In this dimension, it is significant to highlight that the majority of the students indicate that they totally agree that when searching for information on the Internet, they use different strategies that help them find what they

are looking for, such as keywords or search filters (54.1%) or with that it is important to clearly define the achievements that can be achieved with a new project (50.4%).

Regarding prospecting, it was seen that the average of the degrees in Social Sciences (8.80) and Law was higher than that of Engineering and Architecture (7.65). The assumption of normality was verified and, for not being able to assume homogeneity of variances (F=1.50; p=0.224), the Welch correction was applied, by which it was possible to determine that there are significant differences and that the prospecting is greater in the degrees of Social and Legal Sciences, in comparison to Engineering and Architecture degrees (t(135)=3.38; p=0.002), with a high effect size (d=0.841).

4.2. Action Planning

This dimension has an average of 43.6, a figure that is distributed among the three sub dimensions that make it up (*Success orientation*, with 21.4; *Leadership*, with 11.5; *Planning and management of digital identity*, with 10.7).

In relation to this dimension, it is observed that the majority of the students agree that the spread of information is made easier with a profile with a remarkable digital identity (46.8%), that they feel capable of influencing the decisions of the group of work to get to monitor and direct a final product, or that they know how to use digital technologies to communicate to their team the updates of a work process (45.2%), that the design of inclusive projects is a key factor for their success, for example, projects that consider disadvantaged groups, economic or social inequality, functional diversity, etc. (39.6%), that when they have an idea, they use all the resources (material and personal) at their disposal to turn it into a successful final product (37.8%), that it is important to have a well-defined digital identity when tackling digital entrepreneurship projects (37%), or with which they know how to make their personal profile stand out in different social networks such as professional, family, etc. (27.7%).

It is significant to note that the majority of students fully agree with the idea that the proper functioning of a work team is important for the success of an entrepreneurial network project (58.2%), that it is important to have a work team to tackle entrepreneurial projects (51.1%), in which ICTs can help in the design of entrepreneurial projects (48.1%), or that a key to success of entrepreneurial projects is to respect the environment with a vision of the future from the paradigm of sustainability (44%).

With regard to achievement orientation, it was found that the average for women (22.7) is higher than that for men (20.93). Having checked the assumptions of homogeneity and variance, it was found that achievement orientation was statistically higher in women than in men (t(135)=2.6; p=0.009), with a medium effect size (d=0.55).

Group Descriptives				
	Group	**N**	**Mean**	**Median**
Achievement	Men	61	20.9	21.0
	Women	22	22.7	23.0

Table 2. Achievement orientation with respect to gender

4.3. Initiative and Collaboration

The dimension on implementation and collaboration features an average of 53.9, distributed among the subdimensions of *Communication and collaboration* (21.1), *Responsibility and commitment* (15.8), *Creation of digital value* (10.6) and *Initiative* (6.45).

Regarding this dimension, the majority of students agree that ICTs help them to manage their personal network of professional contacts in the virtual world (44.5%) and that they also help them discuss aspects related to work that they are performing (48.5%). In addition, they feel capable of involving others in their innovative ideas (37.1%), of creating private groups on social networks to manage the development of an innovative proposal (37.6%), of using ICTs to share the content of their entrepreneurial project (38.5%), to use the digital resources that contribute to the development of an idea (45.5%), as well as to assume their responsibility in the elaboration and development of innovative projects (41.8%).

Likewise, the students state that they know strategies for using different social networks to improve their visibility on the Internet (30.6%), use tools to create resources and digital content such as videos, audios or presentations (38.8%) and usually collaborate with others to create, integrate and rework digital resources and content (43.3%).

It should be noted that the majority of students indicate that they acknowledge the authorship of the digital content they use (35.4%) or always act respectfully when communicating online (61.9%).

However, the majority of students feel indifferent in relation to taking the initiative to create an entrepreneurial digital project in the future (37.6%), the proper use of open use licenses (34.9%), or the knowledge of basic rules of behavior online (28.6%).

Regarding the initiative, the assumptions of normality and homogeneity of variances were verified and it was found that, with a mean of 6.72 for men and 5.68 for women, there are significant differences between them, in such a way that the initiative sub dimension was statistically higher in men than in women (t(135)=2.2; p=0.029), with a medium effect size (d=0.552).

Group Descriptives				
	Group	N	Mean	Median
Initiative	Men	61	6.72	6.00
	Women	22	5.68	6.50

Table 3. Gender initiative

The assumptions of normality and homogeneity of variances were verified and it was found that there are statistical differences and that the digital value is greater in the degrees of the Social and Legal Sciences group than in Engineering and Architecture (t(135)=2.65; p= 0.014), with a medium effect size (d=0.605).

Independent Samples T-Test						
		Statistic	df	p		Effect Size
DigitalValue	Student´s t	2.50ᵃ	81.0	0.014	Cohen´s d	0.713

Table 4. Digital value with respect to degree of origin

4.4. Management and Security

This dimension has an average of 76.7, which is distributed among the sub dimensions *problem solving* (18.2), *learning from experience* (14.8), *planning and organization* (14.8), "*techno-ethical" vision* (14.7) and *motivation and perseverance* (14.3).

With reference to this dimension, it is found that students agree that ICTs help them find new opportunities during the development of their entrepreneurial project (43.7%) and detect any errors during their work process (45.4%).

In addition, they feel capable of anticipating possible errors and their solutions in the development of a job (42.2%), of proposing improvement strategies to keep the digital entrepreneurship projects they carry out in the future updated (41%) or of managing the development of an entrepreneurial project (33.6%).

Likewise, the majority of the students state that they use various digital resources at their disposal to find solutions with their work team (47.4%), come up with solutions that solve problems in different situations (44%), know strategies to mediate and solve the communication and organization problems of the work group (43.3%), see themselves as being constant and persistent when they start work on an entrepreneurial project (42.9%), are motivated to use ICT in the development of their innovative ideas (40.2%), have the ability to use ICT in data management (35.3%) and use real identities online, always linked to a person or entity (33.3%).

It is significant to highlight that the majority of students indicate that they always take advantage of the problems that arise in a project and see them as a learning opportunity (42.2%), consider it essential to meet the

deadlines in the tasks of an entrepreneurial project (56%) or that they are totally aware of the importance of guaranteeing the protection of the personal data of the participants in the entrepreneurship projects in which they could participate in the future (50.4%).

In contrast, the students are indifferent when stating whether they would be able to easily identify any problem during the development of an entrepreneurship proposal (39.6%), of defining strategies that evaluate the performance of a digital entrepreneurship project (34.1%) or of acting effectively in the face of unforeseen events that arise in the development of a project of this type (77%). Likewise, he expresses indifference when they state whether they would know how to use ICTs to guarantee security and data protection in entrepreneurial projects (31.3%) and they are as well not concerned about knowing for sure whether their ideas will come true (48.1%).

Finally, the same percentage of students express their indifference and agree with considering themselves capable of proposing ICT solutions to problems that arise in a project (37.7%). Indifference can arise from the perception that problems within digital entrepreneurship projects can be complex and multifaceted, leading students to doubt their ability to deliver effective solutions with ICT alone

The resolution presents a t(135)=2.12; p=0.037, so it is verified that there are statistical differences between the Social and Legal Sciences degrees with respect to Engineering and Architecture, resulting in the first group being statistically superior to the second group, with a medium effect size (d=0.605) .

Independent Samples T-Test						
		Statistic	df	p		Effect Size
Resolution	Student´s t	2.12ᵃ	81.0	0.037	Cohen´s d	0.605

Table 5. Resolution regarding title of origin

5. Discussion

In the analysis of the self-perception of the final year undergraduate students of the degrees of the Polytechnic University of Cartagena, and in relation to the EmDigital digital entrepreneurship model, it is observed that the students feel more competent in the management dimension and security, although they perceive that the dimension related to the identification of opportunities is less developed. This may be due to the curricular approach of the curricula, which is likely to place considerable emphasis on the development of skills related to project management and security in the digital environment.

As for the sub dimensions, students consider themselves especially competent in achievement orientation, communication and collaboration, and problem solving (Figure 4).

In relation to the items, within the identification of opportunities, it is worth highlighting that more than half of the students totally agree that they consider it important to clearly define the achievements that can be achieved with a new project. This dimension, as we have seen, is the one that presents the worst results compared to the others and, nevertheless, it is essential in the framework of digital entrepreneurship, just as they indicated Ratten and Usmanij (2021). The lower score in this dimension could indicate an area for improvement in the education and training of students, emphasising the importance of developing a strategic and creative vision that allows them to innovate and successfully undertake in the digital context.

As stated by Chang, Huang and Chiang (2014: p. 14) "the capability of entrepreneurs to identify potential opportunities will surely affect the future development of new ventures". Therefore, it should be a fundamental aspect to work with students.

Regarding action planning, it is highlighted that more than half of the students totally agree that it is important to have a work team to tackle entrepreneurial projects and that the proper functioning of a work team is key for the success of an online entrepreneurial project. This fact is in line with some studies, such as that of Araque, Córdoba and Meriño (2018), in which they state that a work team that fosters an optimal interpersonal environment is fundamental in entrepreneurial initiatives.
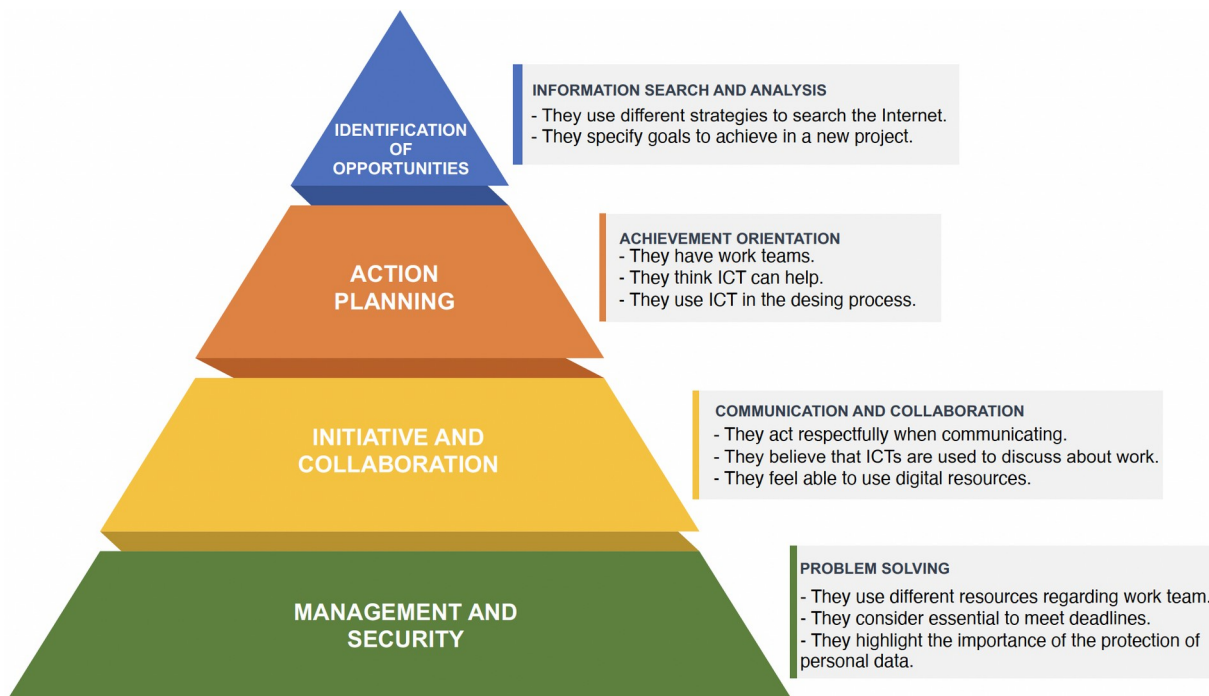
Figure 4. Sub dimensions and indicators in which the students feel more competent

With reference to the dimension of initiative and collaboration, it is especially significant to note that more than half of the students state that they always act respectfully when communicating online. In this sense, it echoes a study carried out by Rodríguez, Romero and Fuentes (2019) focused on online participation, bearing in mind the value of respect, where it was indicated that 85.3% of university students agreed to establish communication on the Internet based on said value, something that is essential to develop the skills that Kluzer and Pujol (2018) mentioned to use technology collaboratively.

Lastly, in relation to the *management and security* dimension, it is worth highlighting that more than half of the students state that they totally agree that it is essential to meet the deadlines of the tasks of an entrepreneurial project or that they are aware of the importance of guaranteeing the protection of the personal data of the participants in the entrepreneurship projects in which they could participate in the future. This is arguably due to data protection in the digital world being a topic that currently arouses much interest (Polo, 2020; Cotino-Hueso, García-Mahamut, Medina-Guerrero, Murillo de la Cueva, Rallo-Lombarte, Rebollo-Delgado et al., 2020). In society, individuals with these skills contribute to the creation of safer and more trustworthy digital environments, promoting responsible practices in the use of technologies. This is essential in an era where cybersecurity and efficient management of digital projects are crucial for economic and social development.

Taking into account the first hypothesis, we can conclude that significant differences have been found in relation to gender for two of the sub-dimensions of the EmDigital model: those referring to achievement orientation and initiative. Specifically, it has been found that men have more initiative than women. A study carried out by Alarcos (2021) indicates that 82.6% of women consider that they have sufficient skills for entrepreneurship. Therefore, delving into the reasons why women have less initiative in relation to digital entrepreneurship may be of interest. Based on these results, the alternative hypothesis (H_a) *There are significant differences in the perception of digital entrepreneurship competencies between genders* is supported. The study reveals significant gender differences in certain aspects of digital entrepreneurship competences, with women scoring higher on achievement orientation and men scoring higher on initiative. Results that do not coincide exactly with those obtained in the study by Tejeiro et al. (2021), which highlighted parity between men and women regarding entrepreneurship. Although similar results are not obtained with the study of Vall-Llosera et al. (2022), which concluded that athletic men who combine studies with paid work have more developed entrepreneurial competence. A study by Segovia-Saiz, Briones-Vozmediano, Pastells-Peiró, González-María and Gea-Sánchez (2021) concludes that women encounter different obstacles such as gender bias in research evaluation, individualism and lack of collaboration, lack of

women's influence, gender inequalities in recruitment and promotion, perceived sexism and discrimination in the work climate, and difficulties in work-life balance.

Regarding achievement orientation, which analyzes, for instance, the encouragement of the participation of other professionals, the creative design of a creative and sustainable entrepreneurship plan and the estimation of costs, women achieve a higher score than men. In a specific study that was carried out within the framework of the project roughly based on gender, it was also found that achievement orientation was greater in women than in men (Román & González, 2022).

In relation to the second hypothesis, the alternative hypothesis (H_a) *There are significant differences in digital entrepreneurship competencies among students from different areas of knowledge* is supported. The study found that there are indeed significant differences in certain competencies between students from different areas of knowledge. It has also been found that in some sub-dimensions (problem solving, digital value and prospecting), students of degrees in Social and Legal Sciences obtain better results than those of degrees in Engineering and Architecture. A study carried out around the PLE (Personal Learning Environments) in students in the last year of Degree in Universities throughout Spain, also found differences between these degrees, for example, around the use of social networks to communicate. The authors indicate that this may be due to the fact that communication and the development of communicative processes may be intrinsic to this branch of knowledge and that this is what explains the data (Gutiérrez, Román & Sánchez, 2018). In this case, something similar can happen, and that the actions related to the sub-dimensions can be an inherent part of the study plans, or the development of the subjects, due to their own nature.

Working transversally helps to meet two objectives: the acquisition of skills such as entrepreneurship and digital, and the rest of general university skills (Laguna, Abad, de la Fuente & Calero, 2020). This implies that it would be important to develop a model such as that of EmDigital to establish a series of common indicators that can be reinforced in all degrees, and in this way, to guarantee that students develop valuable strategies related to digital entrepreneurship, regardless of their original degree once they have graduated. In this way, we will be making it possible not only to improve the job prospects of undergraduate students, but also their professional skills for a digital world.

Dimension	Some findings	Percentages/ Means
Management and Security	Students demonstrated strong competencies in problem-solving, learning from experience, planning and organization, along with a "techno-ethical" vision and motivation. They largely agreed on the effectiveness of ICTs in identifying new opportunities (43.7%) and detecting errors (45.4%) during project development. Students felt confident in anticipating and solving problems, updating digital entrepreneurship projects, and in project management. The study found statistical differences between students from Social and Legal Sciences and those from Engineering and Architecture	76.7 overall average in this dimension
Initiative and Collaboration	Students' competence in communication, responsibility, digital value creation, and initiative. Most students recognized the role of ICTs in managing professional networks (44.5%) and facilitating work-related discussions (48.5%). Men show higher levels of initiative (mean score of 6.72) compared to women (mean score of 5.68).	53.9 overall average in this dimension
Action Planning	Students displayed proficiency in achievement orientation, leadership, and digital identity planning. They largely agreed on the effectiveness of a strong digital identity in spreading information (46.8%) and the importance of inclusive project design (39.6%). Notably, women scored higher in achievement orientation than men, indicating a gender difference in this aspect of digital entrepreneurship.	43.6 overall average in this dimension
Identification of Opportunities	Most students were ambivalent about their capability to contribute to online entrepreneurial initiatives and to develop implementable ideas, yet over 50% confidently use internet search strategies and recognize the importance of defining clear goals for new projects. Notably, students in Social Sciences and Law outperformed their peers in Engineering and Architecture in prospecting skills.	28.9 overall mean in this dimension.

Table 6. Dimensions, findings and percentages of the research

6. Conclusions

In conclusion, it is observed that students feel more competent in the use of different Internet search strategies and in specifying objectives to achieve in a new project.

Furthermore, they believe that ICT can help in the design process and believe that ICT is used to discuss the work. They also feel capable of using digital resources and different resources related to the work team.

Finally, they act respectfully when communicating and consider compliance with deadlines essential.

This study highlights the importance of working in higher education in an interdisciplinary manner, limiting excessive separation or division of content traditionally linked to specific disciplines or areas, since if we want to improve students' digital entrepreneurship competence, it will be necessary to provide cross-cutting training from technology, economics, and education that contribute as a whole to the needs that future professionals in society will present.

The study's findings show differences in digital entrepreneurship competencies based on gender and academic discipline, point to the potential for improving course designs and teaching strategies. It could be concluded that there is a need for an interdisciplinary approach in higher education to enhance digital entrepreneurship competencies. It underscores the importance of integrating cross-disciplinary training, combining elements from technology, economics, and education, to meet the evolving needs of future professionals. This insight is particularly valuable for university policies aimed at developing digital entrepreneurship skills among students.

Therefore, regarding the three objectives of this work (to identify the profile of final-year students in terms of their digital entrepreneurship competence development; to analyze students' knowledge of the processes for implementing and collaborating in digital entrepreneurship; and to identify possible differences in terms of gender and degree in relation to final-year students' digital entrepreneurship competences and perceptions), affirm that they are met in a significant percentage.

This research can be taken into account in university policies and teaching strategies focused on the development of digital entrepreneurship skills in students, taking into account that technology itself does not have to limit the development of these skills nor the ability to think or develop critical sense whenever educational institutions train for appropriate use, based on their analysis and reasoning. Indeed, the findings suggest that there is potential for improving students' competence in identifying opportunities, which can be useful for the design of courses. The gender and academic branch differences found in different dimensions of digital entrepreneurship can help inform specific educational interventions and strategies, fostering greater equity in digital entrepreneurship skills.

Among the limitations of the study, it could be interesting add other variables, such as the students' previous experience in the digital environment or the training received in this field or outside school, that might be considered for future experiences. It is also possible to assess aspects such as whether students are already working and how work environments can help the development of digital entrepreneurship skills.

This study can be applied in the future to new generations in order to be able to consider an analysis over the years. It can also assess qualifications from different backgrounds. It is possible to replicate this research, as it can be carried out in other institutions and grades, and also to extend the model and address the analysis of faculty and institutions in relation to digital entrepreneurship. Another interesting initiative would be to propose a research based on design, where a plan for the development of digital entrepreneurship competence could be integrated.

Declaration of Conflicting Interests:

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

References

Alarcos, T. (2021). *El emprendimiento digital en femenino en España: situación y prospección: mujeres, tecnología y sociedad digital.* Instituto de la mujer. Catálogo de publicaciones de la Administración General del Estado. https://cutt.ly/9Jjdstp

Araque, Y., Córdoba, V., & Meriño, M. de (2018). El clima organizacional en el emprendimiento sostenible. *Revista Escuela de Administración de Negocios*, 84, 43-61. https://doi.org/10.21158/01208160.n84.2018.1916

Bacigalupo, M., Kampylis, P., Punie, Y., & Van den Brande, G. (2016). EntreComp: The Entrepreneurship Competence Framework. *JCR Science for Policy Report.* Available at: https://core.ac.uk/download/pdf/38632642.pdf

Bosma, N., Hill, S., Ionescu-Somers, A., Kelley, D., Guerrero, M., & Schott, T. (2021). *Global Entrepreneurship monitor. 2020/2021 global report.* GEM. Available at: https://cutt.ly/IJjdobe

Carretero-Gomez, S., Vuorikari, R., & Punie, Y. (2017). *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use.* Publications Office of the European Union. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC106281

Chang, W.L., Huang, W.G., & Chiang, C. (2014). A Study of the Relationship between Entrepreneurship Courses and Opportunity Identification: An Empirical Survey. *Asia-Pacific Management Review,* 19, 1-24. https://doi.org/10.6126/APMR.2014.19.1.01

Cotino-Hueso, L., García-Mahamut, R., Medina-Guerrero, M., Murillo de la Cueva, P.L., Rallo-Lombarte, A., Rebollo-Delgado, L. et al. (2020). Encuesta sobre la Protección de Datos Personales. *Teoría y Realidad Constitucional*, 46, 15-118. https://doi.org/10.5944/trc.46.2020.29105

Esteve, F., & Gisbert, M. (2013). Competencia digital en la educación superior: instrumentos de evaluación y nuevos entornos. *Enl@ce: Revista Venezolana de Información, Tecnología y Conocimiento*, 10(3), 29-43. Available at: https://www.redalyc.org/pdf/823/82329477003.pdf

European Union (2006). *Recommendation of the European Parliament and the council of 18 December 2006 on key competences for life long learning.* Available at: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:394:0010:0018:en:PDF

European Union (2019). *Key competences for lifelong learning.* Available at: https://op.europa.eu/en/publication-detail/-/publication/297a33c8-a1f3-11e9-9d01-01aa75ed71a1/language-en

González, V., Prendes, M.P., & Solano, I.M. (2022). Instrumento de análisis de la competencia de emprendimiento digital en educación superior. *Relieve, Revista Electrónica de Investigación y Evaluación Educativa,* 28(1), 1-19. https://doi.org/10.30827/relieve.v28i1.22831

Gutiérrez, I., Román, M., & Sánchez, M. (2018). Strategies for the communication and collaborative online work by university students. *Comunicar*, 54, 91-100. https://doi.org/10.3916/C54-2018-09

Kluzer, S., & Pujol, L. (2018). DigComp into action: Get inspired, make it happen. A user guide to the European Digital Competence Framework. *JRC Research Reports.* Joint Research Centre. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC110624

Laguna, P., Abad, P., de la Fuente, C., & Calero, R. (2020). A university training programme for acquiring entrepreneurial and transversal employability skills, a students' assessment. *Sustainability*, 12(3), 796. https://doi.org/10.3390/su12030796

Lilleväli, U., & Täsk, M. (2017). Competence Models as a Tool for Conceptualizing the Systematic Process of Entrepreneurship Competence Development. *Education Research International.* https://doi.org/10.1155/2017/5160863

Lisetchi, M., & Brancu, L. (2021). The entrepreneurship concept as a subject of social innovation. *Procedia. Social and Behavorial Sciences*, 124, 87-92. https://doi.org/10.1016/j.sbspro.2014.02.463

Mason, C., & Arshed, N. (2013). Teaching entrepreneurship to university students through experiential learning: A case study. *Industry and Higher Education,* 27(6), 449-463. https://doi.org/10.5367/ihe.2013.0180

Mavlutova, I., Lesinskis, K., Liogys, M., & Hermanos, J. (2020). The Role of Innovative Methods in Teaching Entrepreneurship in Higher Education: Multidisciplinary Approach. *Reliability and Statistics in Transportation and Communication* (684-693). https://doi.org/0.1007/978-3-030-44610-9_66

Mawson, S., Casulli, L., & Simmons, E.L. (2023). A Competence Development Approach for Entrepreneurial Mindset in Entrepreneurship Education. *Entrepreneurship Education and Pedagogy*, 6(3), 481-501. https://doi.org/10.1177/25151274221143146

McCallum, E., Weicht, R., McMullan, L., & Price, A. (2020). *EntreComp into Action: get inspired, make it happen*. Publications Office of the European Union. https://doi.org/10.2760/574864

Mishra, P., & Koehler, M.J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record,* 108(6), 1017-1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Ministerio de Universidades (2021). *Datos y cifras del Sistema Universitario Español. Publicación 2020-2021*. Ministerio de Universidades.

Nambisan, S. (2017). Digital entrepreneurship: Toward a digital technology perspective of entrepreneurship. *Entrepreneurship theory and practice*, 41(6), 1029-1055. https://doi.org/10.1111/etap.12254

Polo, A. (2020). El derecho a la protección de datos personales y su reflejo en el consentimiento del interesado. *Revista de Derecho Político*, 1(108), 165-194. https://doi.org/10.5944/rdp.108.2020.27998

Premand, P., Broadmann, S., Almeida, R., Grun, R., & Barouni, M. (2016). Entrepreneurship Education and Entry into Self-Employment Among University Graduates. *World development*, 77, 311-327. https://doi.org/10.1016/j.worlddev.2015.08.028

Prendes, M.P. (2022). Formar para el emprendimiento digital: construyendo los ciudadanos del siglo XXI. *RiiTE Revista Interuniversitaria de Investigación en Tecnología Educativa*, 12, 1-19 https://doi.org/10.6018/riite.525101

Prendes, M.P., & García, P.A. (2020). Modelo EmDigital: áreas e indicadores de la competencia de emprendimiento digital. In Archundia, E., León, M.A., & Cerón, C. (Eds.), *Redes de aprendizaje digital en nodos colaborativos* (361-372). Benemérita Universidad Autónoma de Puebla. https://doi.org/10.6018/red/56/7

Prendes, M.P., Gutiérrez, I., & Martínez, F. (2018). Competencia digital: una necesidad del profesorado universitario en el siglo XXI. *Revista de Educación a Distancia (RED)*, 18(56), 1-22. Available at: https://revistas.um.es/red/article/view/321591

Prendes, P., Solano, I.M., & García, P.A. (2021). EmDigital to promote digital entrepreneurship: the relation with open innovation. *Journal Open Innovation Technology Market and Complexity,* 7(63), 1-14. https://doi.org/10.3390/joitmc7010063

Ratten, V., & Usmanij, P. (2021). Entrepreneurship education: time for a change in research direction? *The International Journal of Management Education*, 19. https://doi.org/10.1016/j.ijme.2020.100367

Rodríguez, A.M., Romero, J.M., & Fuentes, A. (2019). Ampliando fronteras de comunicación y colaboración a través de la red: la competencia digital como medio para promover la interculturalidad académica. *Tendencias Pedagógicas,* 33, 59-68. https://doi.org/10.15366/tp2018.32.005

Román, M.M., & González, V. (2022). La competencia de emprendimiento digital en función del género: el proyecto EmDigital. *Hachetetepé. Revista científica de Educación y Comunicación,* 24, 1-13. https://doi.org/10.25267/Hachetetepe.2022.i24.1205

Sam, C., & van der Sijde, P. (2014). Understanding the concept of the entrepreneurial university from the perspective of higher education models. *Higher Education*, 68, 891-908. Available at: https://link.springer.com/article/10.1007/s10734-014-9750-0

Segovia-Saiz, C., Briones-Vozmediano, E., Pastells-Peiró, R., González-María, E., & Gea-Sánchez, M. (2021). Techo de cristal y desigualdades de género en la carrera profesional de las mujeres académicas e investigadoras en ciencias biomédicas. *Gaceta Sanitaria,* 34(4), 403-410. https://doi.org/10.1016/j.gaceta.2018.10.008

Seikkula, J., Salomaa, M., Jónsdóttir, S.R., McCallum, E., & Israel, H. (2021). EU Policies Driving Entrepreneurial Competences-Reflections from the Case of EntreComp. *Sustainability,* 13, 8178. https://doi.org/10.3390/su13158178

Spante, M., Sofkova, S., Lundin, M., Algers, A., & Wang, S. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education,* 5(1), 1-21. https://doi.org/10.1080/2331186X.2018.1519143

Tejeiro, M.R., Molina, M.M., & García, J.C. (2021). Emprendimiento digital femenino para el desarrollo social y económico: Características y barreras en España. *Reverso: Revista de estudios cooperativos,* 138, 111-124. https://doi.org/10.5209/reve.75561

Vall-Llosera, L., Repart, G., Saurina, C., & Serra, L. (2022). Entrepreneurial skills in university degrees. *Intangible Capital*, 18(2), 182-194. https://doi.org/10.3926/ic.1542

Zaheer, H., Breyer, Y., & Dumay, J. (2019). Digital entrepreneurship: An interdisciplinary structured literature review and research agenda. *Technological Forecasting and Social Change*, 148, 1-20. https://doi.org/10.1016/j.techfore.2019.119735

Zhao, Y., Pinto, A.M., & Sánchez, M. (2021). Digital competence in higher education research: A systematic literature review. *Computers & Education,* 168, 104-212. https://doi.org/10.1016/j.compedu.2021.104212