ALLIES

Digital Training Tools in Steel Structure Integrity

Teachers needs and perception analysis on Digital (PR1)

Project coordinator:

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Contents

1 Aims

PR1 aims at conducting a research analysis on digital training methodologies already in use and on the needs felt by the teachers and trainers to improve their knowledge, skills and competencies on digital tools in the field of steel structures.

1.1 Needs

- To fill the knowledge gap that exists in digital teaching, in terms of digital tools and teaching methodologies in digital environment.
- To contribute to the digital transformation of education through innovative approach related to digital teaching, learning and assessment

1.2 Target groups

Teachers and Trainers

1.3 Introduction

The European Commission carried out an extensive public consultation process in June-September 2020 to review the action plan for digital education, which brought together more than 2,700 contributions and 136 position papers from 60 countries.
According to the study, the main issues at EU level were that 60% of respondents did not use distance and online learning tools before the crisis and 95% of respondents consider that this crisis of COVID-19 marks a point from which it is not possible to return to the previous situation in terms of how to use technology in the field of education and training. ALLIES partners also met the issues presented above, in their educational activities.
Digital learning includes a wide range of methodologies and may take place on just about any place and any time. Digital learning" is a learning method based on the use of **new digital tools** to enable learners to learn in a different way, whether it be face-to-face, distance learning (asynchronous or synchronous) or blended learning". **It is therefore not simply a question of digitising educational content** but of a set of educational methods.

2 PR1.T1. Microlearning need and expectations

PR1.T1- elaboration of technical report related to how microlearning can improve the fast learning in the field of STEM

This task started with a questionnaire distributed among different higher education institutions and vet centres in the different partners countries. First, it was made a characterisation of the target group involved in the questionnaires, which is important to evaluate the real situation of the teachers and trainer and to understand what can be done in terms of teaching and training in the future. Afterwards questions concerning needs and expectations about digital Learning, particularly, microlearning were analysed.

2.1 Characterization of the target group and actual situation

The questionnaires were sent to higher education institutions and vet centres in the different partners countries and 60 answers were received. The main characteristics of the participants, namely country, type of organization, position and age of the participants can be seen in figure 1.

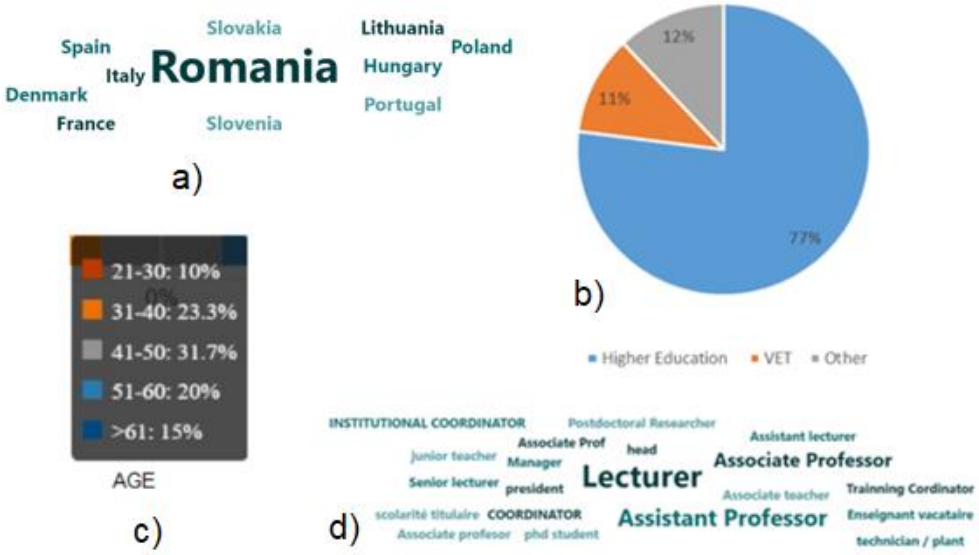


Figure 1. a) Country; b) Sector, c) Age and d) position of the participants of the ALLIES questionnaires

Base on the questionnaires it was observed that around 86% of the teachers and trainers have the technological and pedagogical infrastructures for distance learning solutions, 66% uses digital tools for teaching purposes, while 25% rarely use those tools/devices

(figure 2). In terms of Digital transition half of the teachers found it difficult and the other half didn't have any problems.

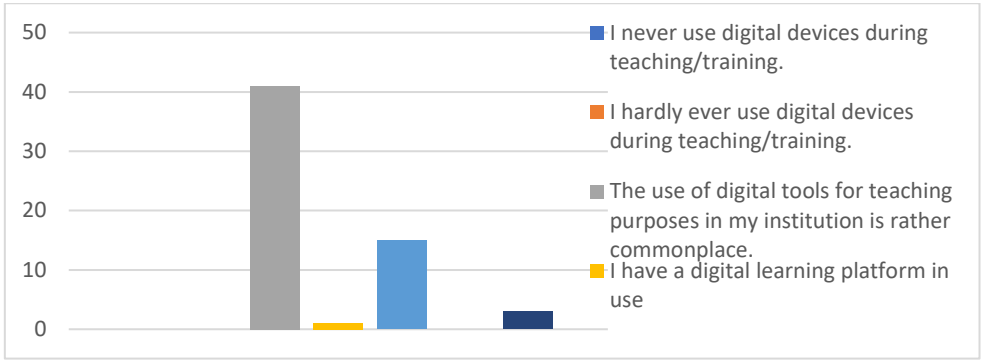


Figure 2 – Question Nº6 "How often do you use digital tools for teaching/training in your institution? "

A problem that was detected throughout the questionnaires was the lack of time, for preparing the classes, for training, (figure 3). Although teacher and trainers have lack of time, 82% agree that complementary training would help to acquire digital skills (figure 4).

Figure 3. – Question Nº11 "What problems did you face during the digital transition?"

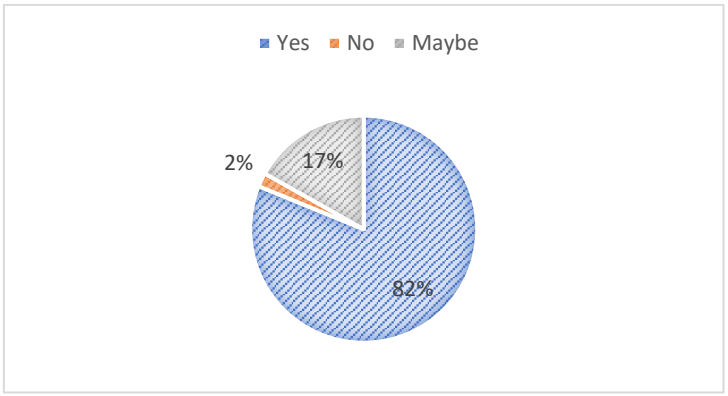


Figure 4. – Question Nº 12 "Do you think complementary training could help you acquire digital skills?"

In a digital education context, most of the teachers and trainers have contact with the students at least once in a week, and with respect to evaluation process most of the students are evaluated trough activities during the online classes (Figure 5 and 6, respectively).

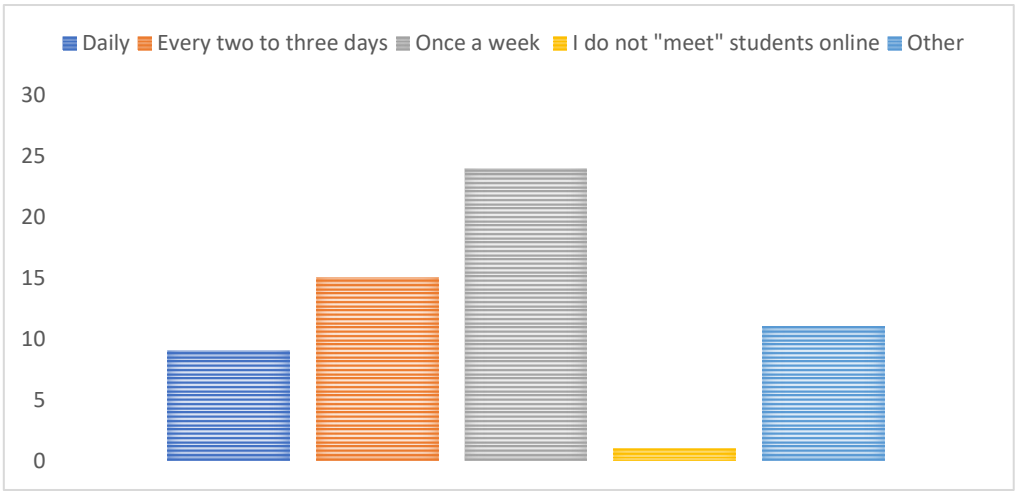


Figure 5 - Question Nº13, "How often do you have digital contact with your students?"

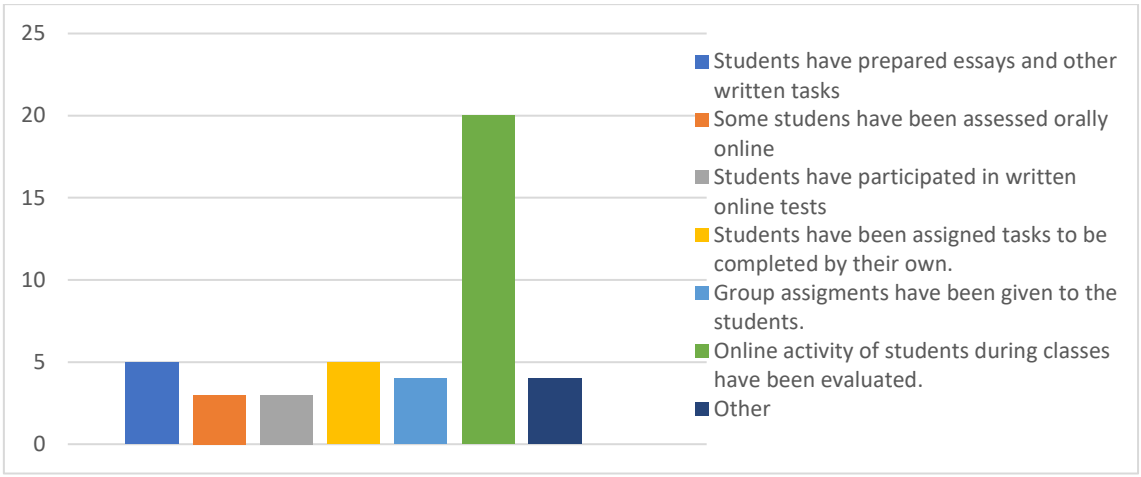


Figure 6 - Question Nº14 "Please indicate how you assess your students in a digital educational context"

2.2 Needs and expectations

To understand the major needs and expectation of digital education, and particularly in what micro-learning is concerns, as it was verified that the Lack of time is one of the main obstacles to learning and training, some questions were made for which the results are summarised in this section.

To start with, it can be seen in figure 7, that there are still different fields where it is necessary to act to improve teachers digital training competences and skills, namely the *lack of materials specific for digital teaching*. Also, as indicated in figure 8, the *teaching methods and evaluation methods and communication tools must be adopted to these new methodologies of teaching*, once again emphasising the need of training in digital teaching methodologies.

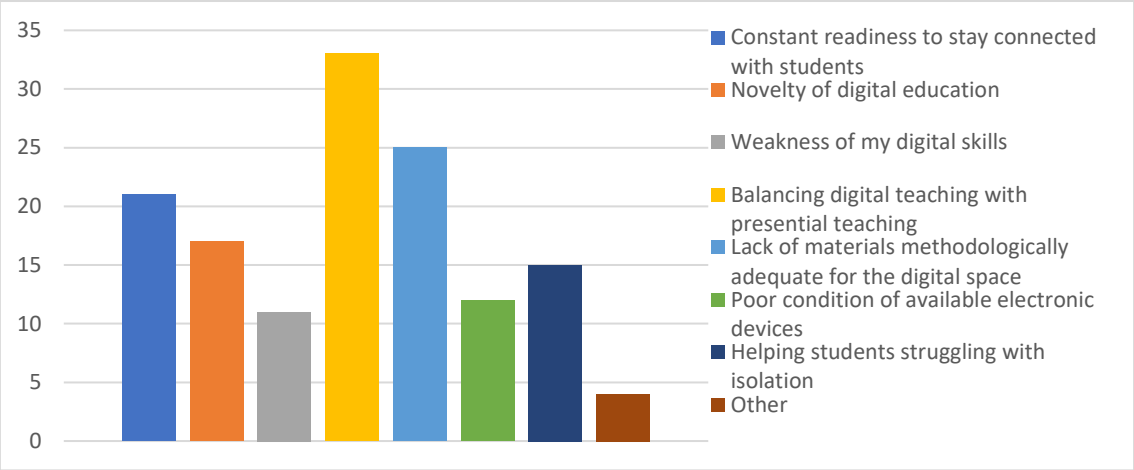


Figure 7 – Question Nº15 "Indicate the challenges you have had to face during digital learning".

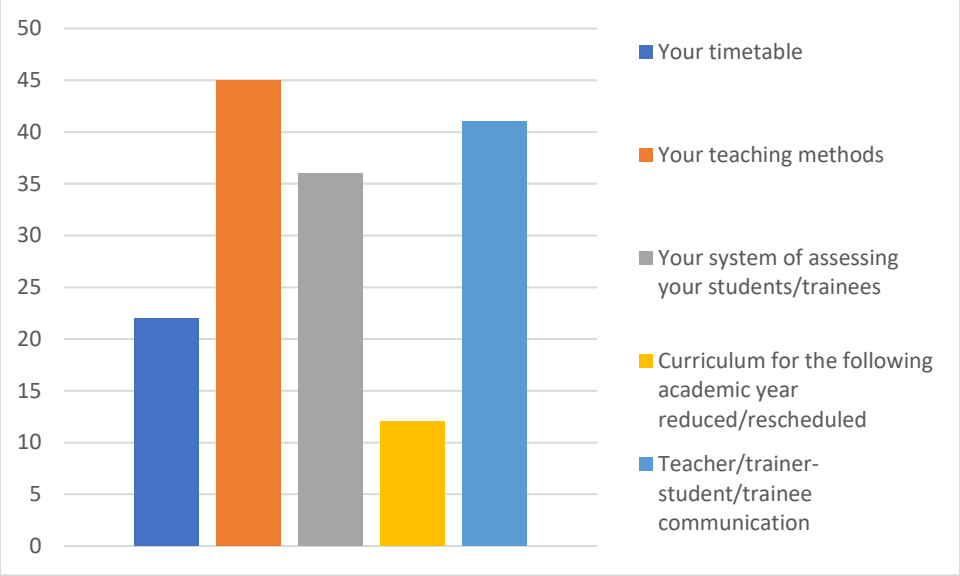
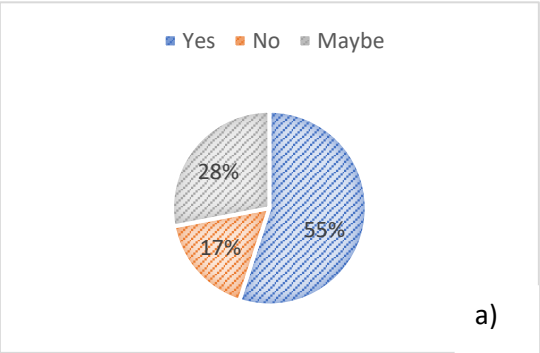


Figure 8 – Question Nº16 "Have you had to change any of the following because of digital learning?"



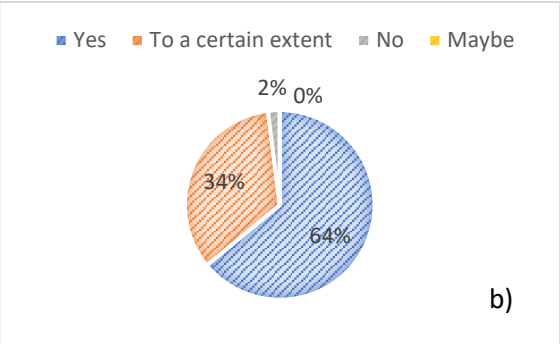


Figure 9 – a) Question N.18 "Do you have time for your own learning?" and b) question N19 "Do you think digital learning will have a long-term impact on education/training?"

In figure 9 it can be observed that approximately half of the teachers/trainers have time for “own learning”, although, more than that percentage, around 98%, agrees that digital education will have a long-term impact on education/training, with the flexibility, learning at own pace, being the main advantage of the digital education in the future, followed by innovative and engaging ways of learning, innovative tools and online platforms and innovative learning materials (figure 10). Once again, these results allow to conclude that digital education is very important allowing pace learning, as well as an increase in availability and a better management of time to “learn” (figure 11).

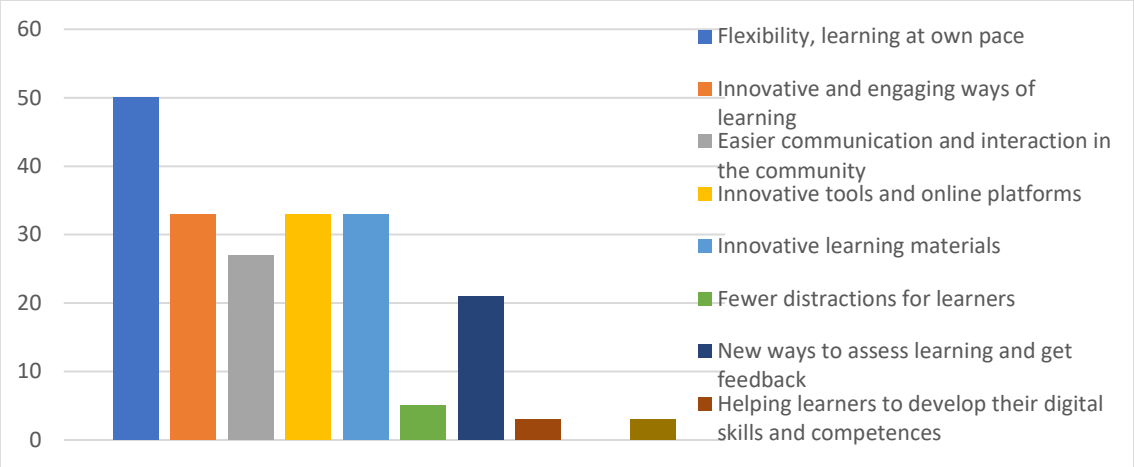


Figure 10 –Question Nº20 “What do you think could be the main advantages of digital education in the future?”

The last two questions of the first questionnaires aimed at having a broader overview of the expectations and needs in terms of digital Learning in Europe. Based on the analysis of these results it was verified that, as in most of the fields, socioeconomic inequalities between learners continue to be the biggest challenge, followed by the lack of plan and vision for integrating digital technologies in education and training in terms of Digital Learning in Europe; Lack of European high-quality online learning content and lack of availability of suitable digital tools and technologies.

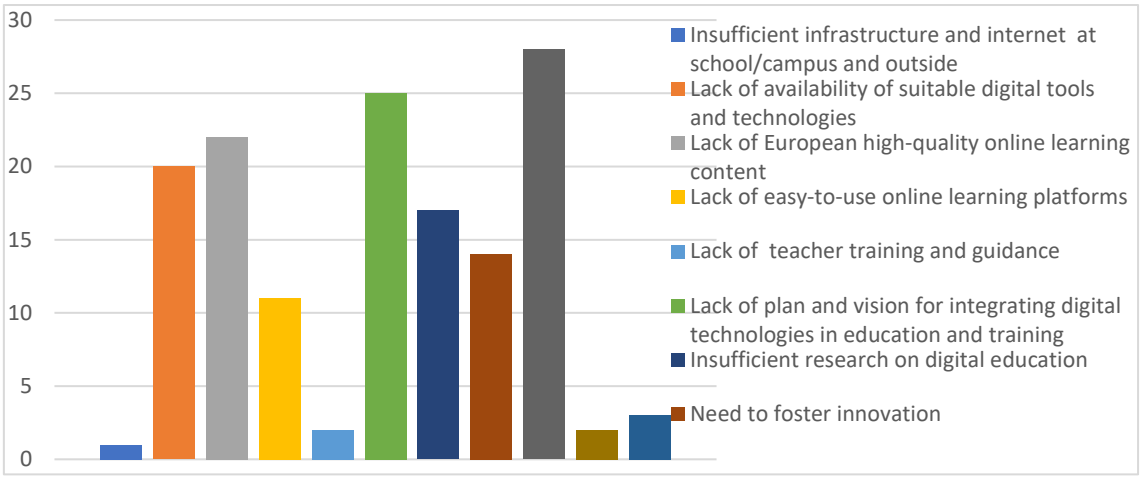


Figure 11 – Question Nº21 "What are the biggest challenges for digital learning in Europe?"

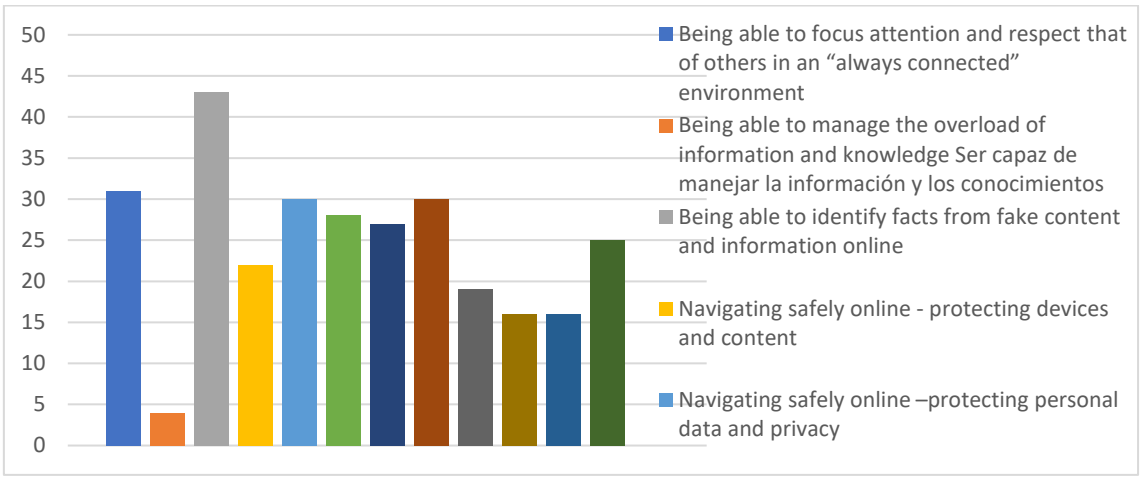


Figure 12 - Question Nº22 "Which of the following digital skills and competencies are the most important to work in the 21st century?"

2.2.1 Conclusion of PR1.T1

The results obtained in the first questionnaires are in line with the scope of the ALLIES project where the need of training in digital learning is important, being necessary to obtain and develop new teaching materials, tools and methodologies. Time, of lack of it, was the problem most highlight in what training was refer, meaning that micro-learning and micro-course are the best option to overcome this limitation.

3 PR1.T2. Digital training methodologies

3.1 How digital training methodologies can improve the fast learning in the field of STEM

This task aims at collecting feedback on expectations and future career perspectives from teachers and trainers on the possible improvements they can get with the application of Digital Training Methodologies.

To start, it is important to understand which tools are the most relevant to give high quality digital teaching. For almost all teachers and trainers the presentation instruments and online communication tools are considered the most important tools (figure 13).

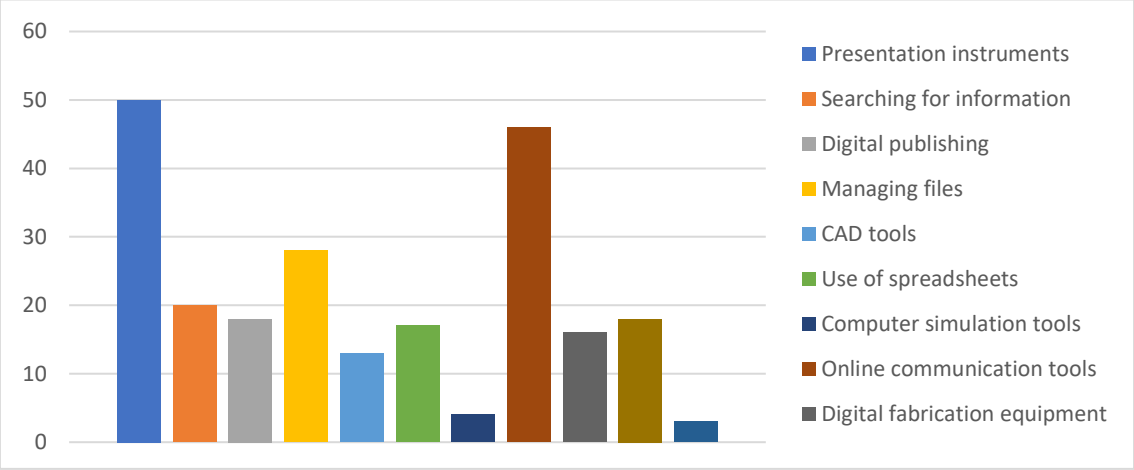


Figure 13. Question Nº 17 "Which digital tools do you think are the most important in order to be able to perform digital teaching?"

In term of the topics that are important to address in terms of digital training the participants have indicated the following, according by order of relevance: the identification of *online fake content and information* as well as *cybersecurity matters*, the *ability to respect the others* in a "always connected environment", creation *of digital content* and the use of *digital tools* to solve the problems. These topics should be part of any training program in digital teaching (figure 14).

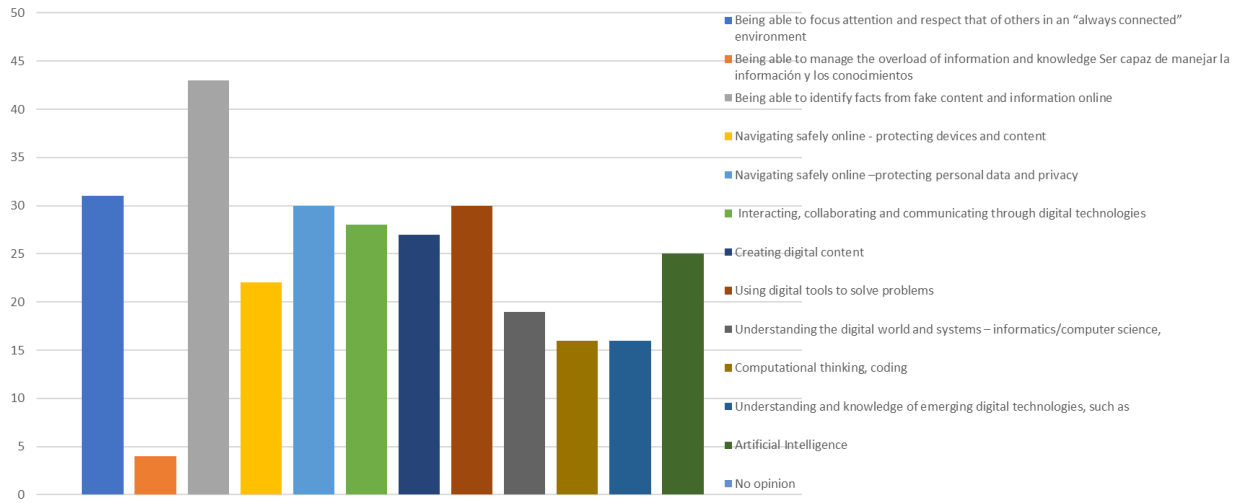


Figure 14. Question Nº 22 "Which of the following digital skills and competencies are the most important to work in the 21st century?"

Additionally, to the previous identified topics, and in order to improve the learning process and making it faster it is important to understand what makes online learning resources and content useful, for that, and through the analysis of the questionnaires results, it was observed that having interactive resources, easy to use, with high quality and relevant contents, that are designed to address the needs of the learners, it can be obtain a better learning process (figure 15).

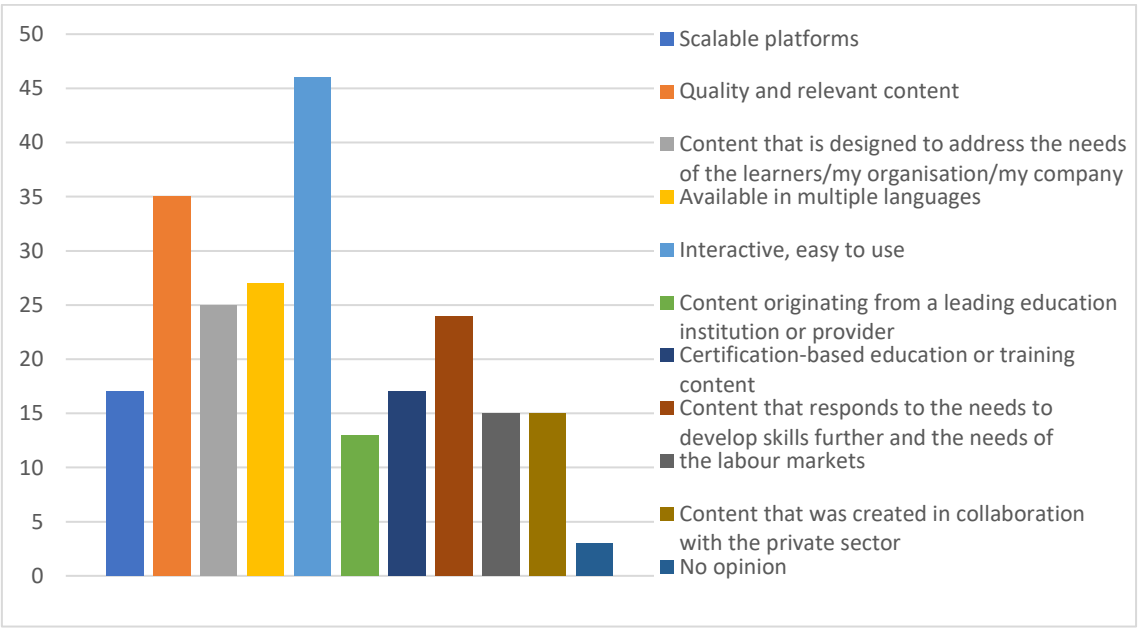


Figure 15 – Question Nº 23 "In your experience, what makes online learning resources and content useful?"

For a training institution to be able to provide digital education it is necessary first of all to have teachers with relevant digital skills, follow by the need of having digital

resources, materials, and infrastructures and to have a vision and strategy for using digital technologies in the education and training process (figure 16).

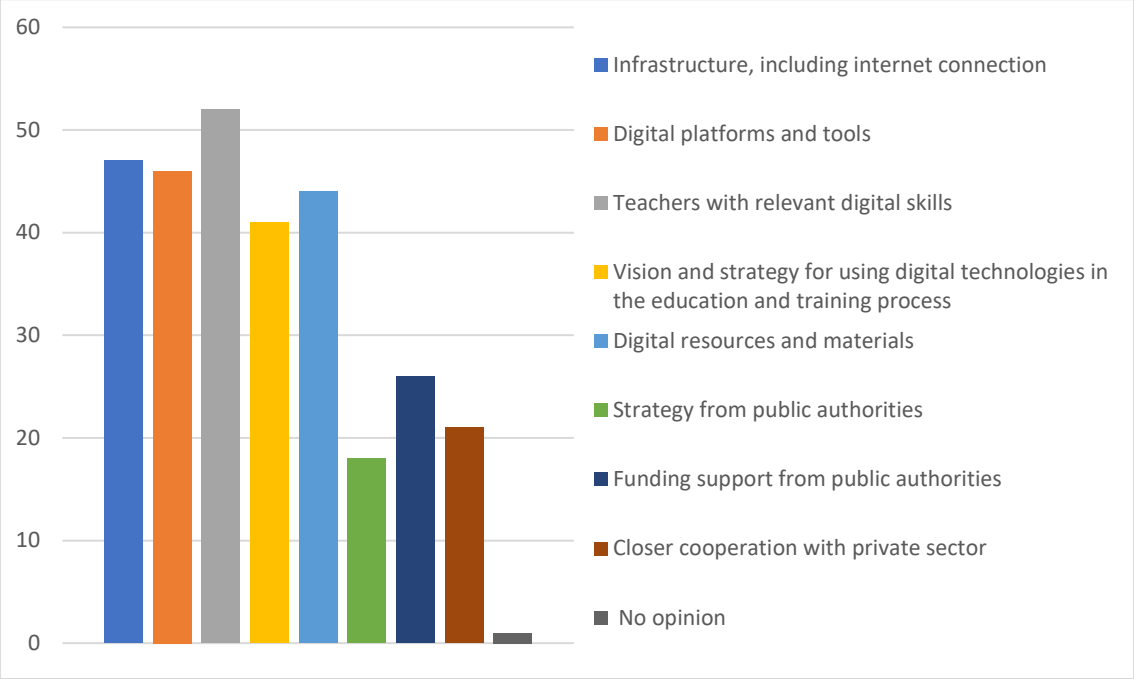


Figure 16 – Question Nº 24 "What does an education and training institution need to be able to provide digital education?

Focusing on the EU added value when it comes to digital education, it was observed, in line with the results previously obtained, that *teacher training and guidance on digital education* is the most import topic to considered follow by provision of digital technologies and tools and the support to develop digital education strategies and exchange of good practices (figure 17).

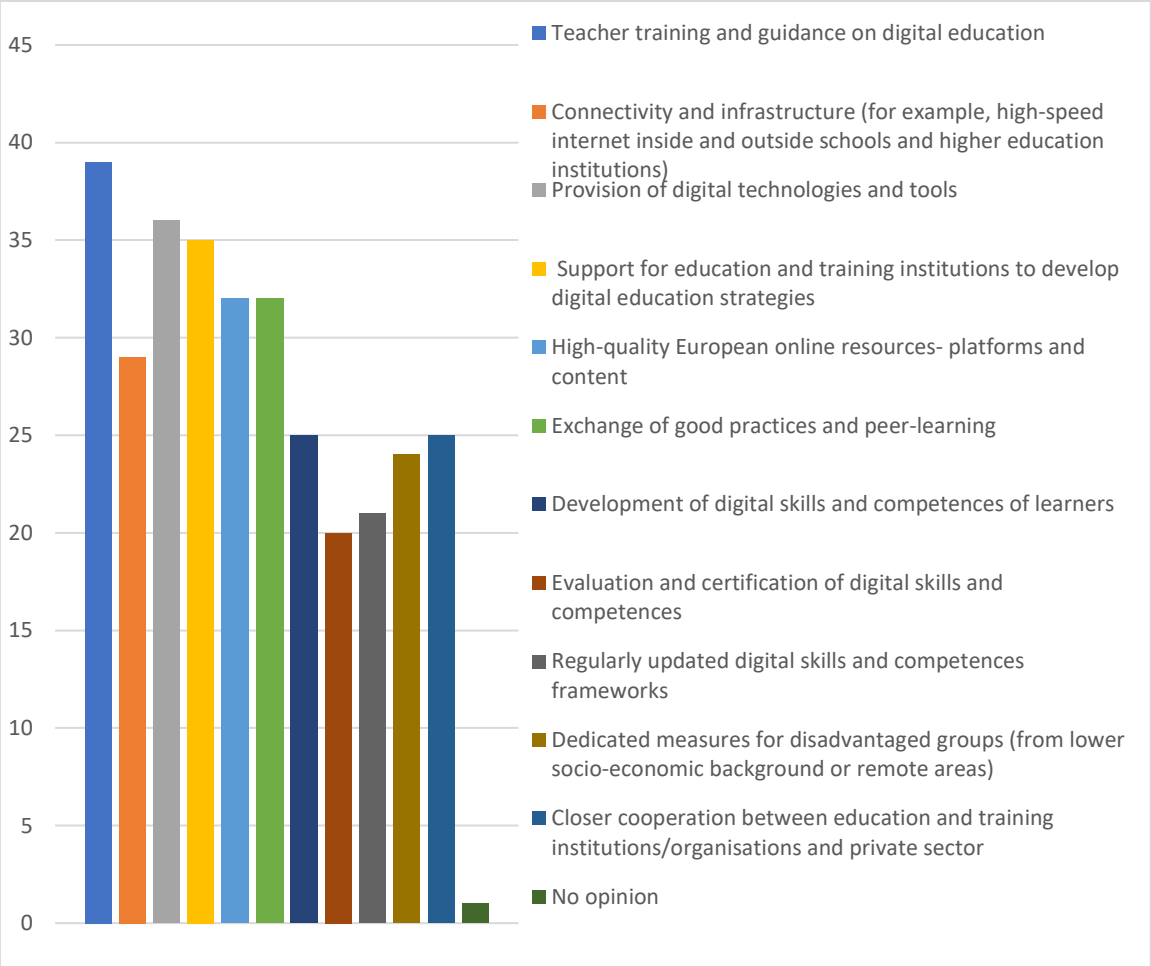


Figure 17 – Question Nº 25 "Where could the EU add value when it comes to digital education?"

In what supplementary training or education is concern, most of the teachers and trainer consider that the hybrid, face-to-face and online combine, is the best option, although the online methodology was not specified (fig 18). However, in figure 19, in terms of lesson type the traditional 45 min, lecture is the most voted (53%), the reason for that it might be related with the population involved in the survey, being the majority teachers in higher education, which means that ate more traditional, although complaining about the time available for receiving training. The short term and micro-curses represent a 45% of votes, which has also a high weight in the decision.

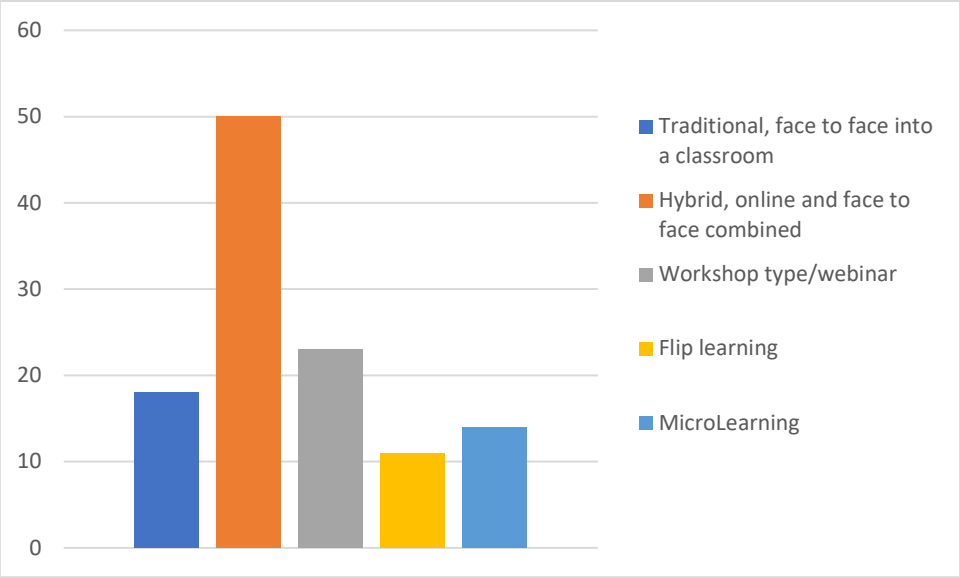


Figure 18 – Question Nº 26 "What would you consider optimal for the future in terms of supplementary training or education?"

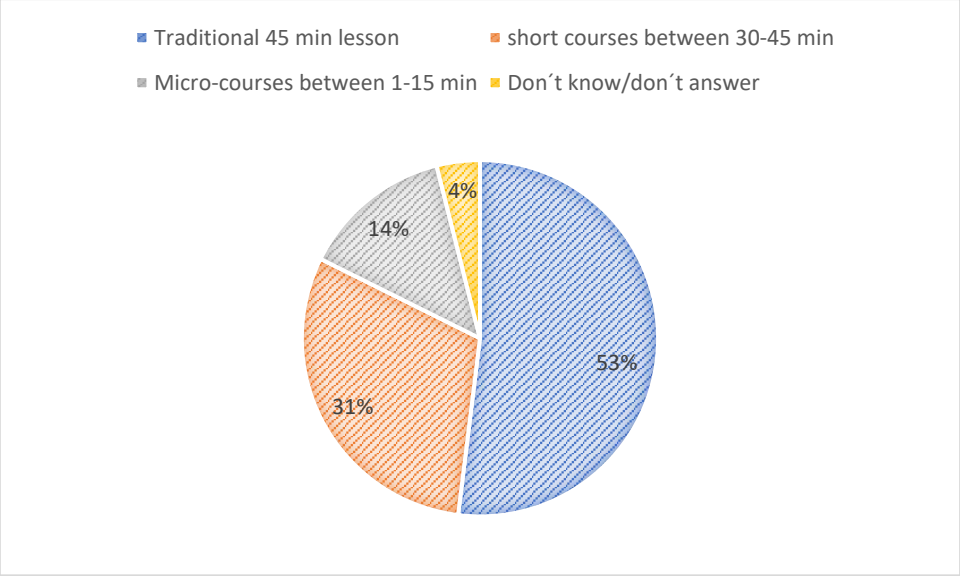


Figure 19 – Question Nº 27 "What would you consider optimal for the future in terms of Type of lesson?"

In terms of course duration, based on the answers, it can be considered a short course duration, as the maximum hours indicated were between 8h-40h (figure 20).

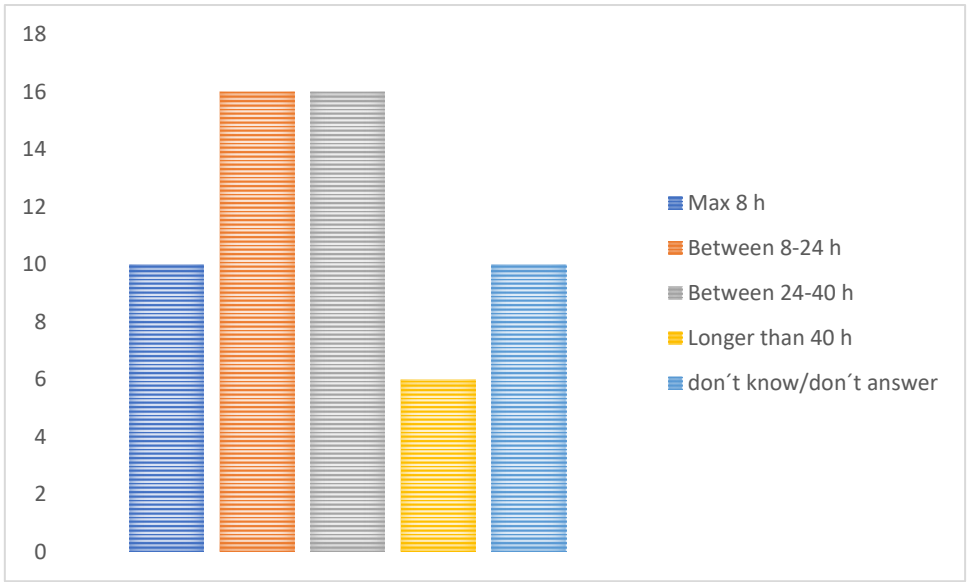


Figure 20 – Question Nº 28 "What would you consider optimal for the future in terms of course duration?"

For presential classes a classroom in a school is considered the best location (fig 21), while in term of subject to be taught, the majority of participants prefers to have the topic(s) proposed to which others can be added based on the lack of knowledge experienced (fig 22).

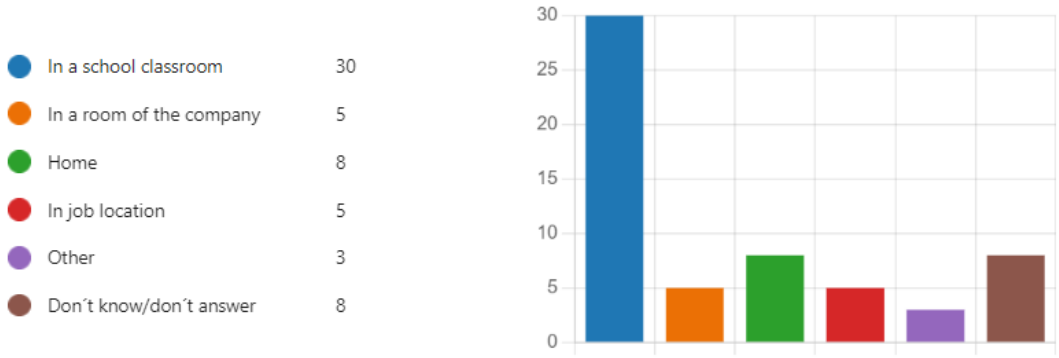


Figure 21- Question Nº 29 "What would you consider optimal for the future in terms of Location of course?"

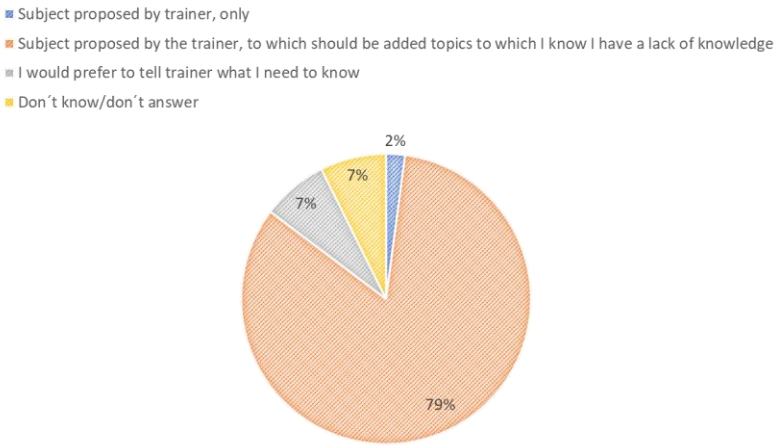


Figure 22- Question Nº 30" What would you consider optimal for the future in terms of Subject"

To analyse how digital tools and methodologies can be implemented for fast learning, several questions were made, and the answers obtained analysed. The results of this analysis allowed to indicate that the learning platform are mainly use for downloading study materials, for communication purposes, for study in the course, submit task and evaluation (fig 23). However, to make pedagogical work more effective in the future a collection of digital visualisation tools (videos, 3D models, etc.), digital textbooks, good practices regarding classroom collaboration with students, between others (fig. 24) should be developed.

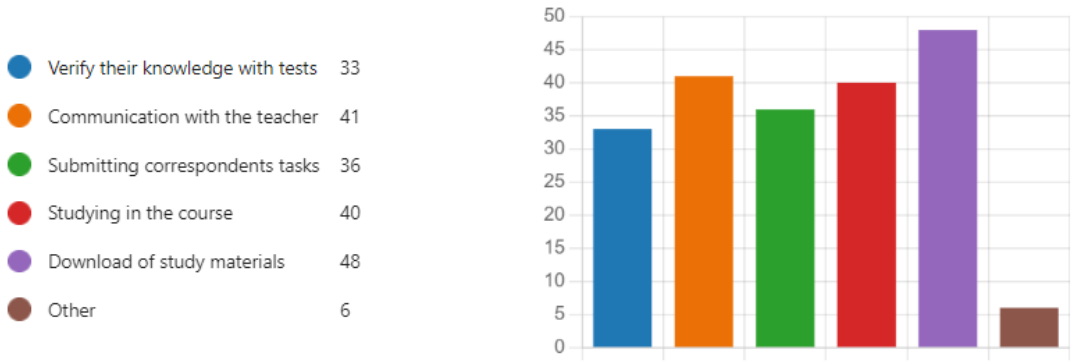


Figure 23- Question Nº 32 "Students/trainees use learning platforms for:"

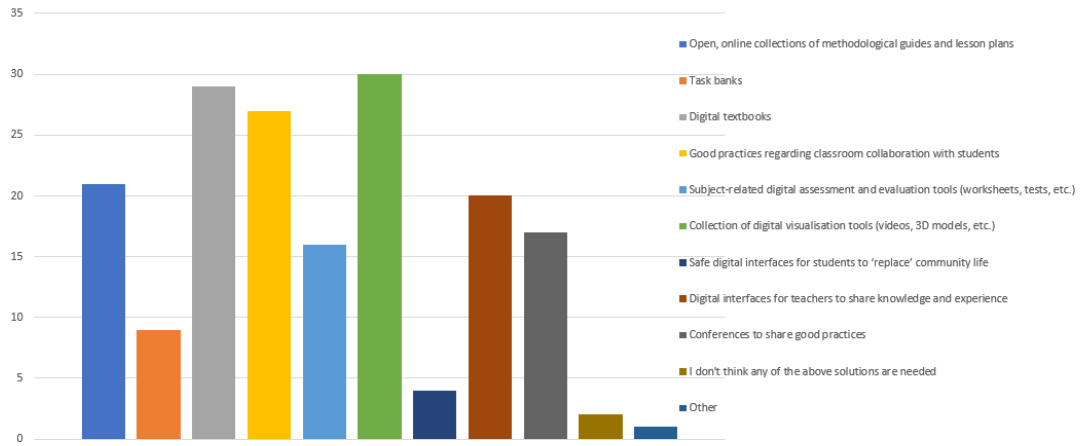


Figure 24- Question Nº 33 "What digital solutions do you think could make pedagogical work more effective in the future? Please select from 1 to 3 answers"

There are several digital/pedagogical tools relevant for e-learning that can be used separately or in combination, being in the top 3 of preferences the videos, simulators, and eBooks (figure 25).

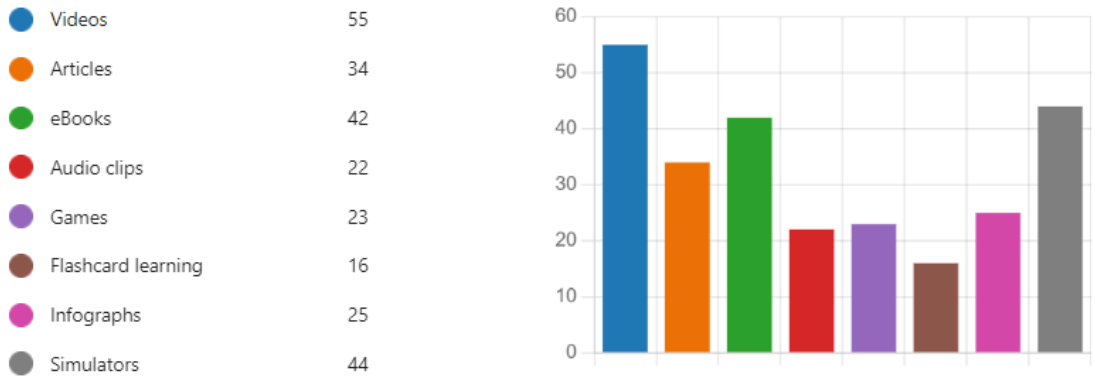


Figure 25- Question Nº 34 "Identify the digital/pedagogical tools you consider to be or could be relevant for e-learning"

In terms of digital platforms/apps Microsoft teams is the winner, followed by the Zoom platform (fig 26). These applications are mainly used for communication, for training and for Video conferencing/webinar (fig 27).

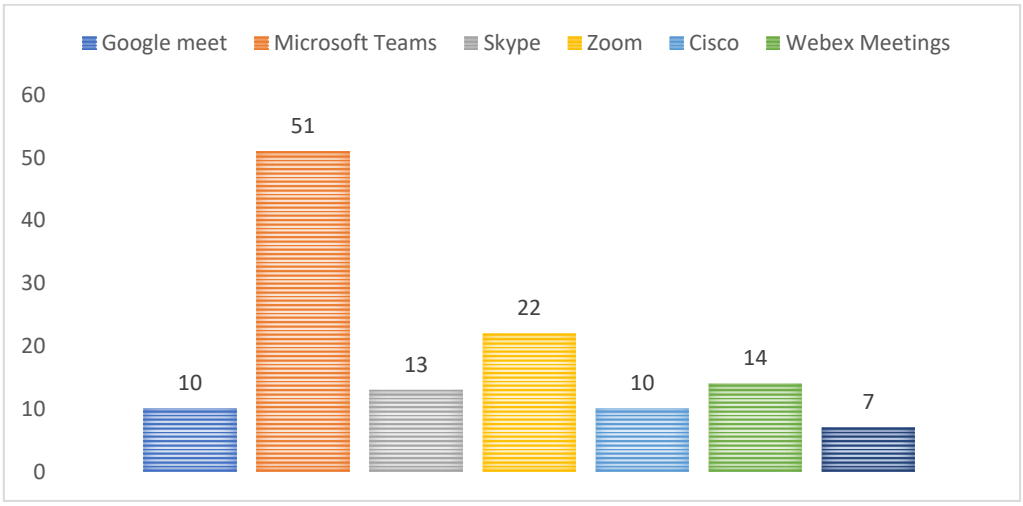


Figure 26- Question Nº 35 "What digital platforms/apps does your institution use?"

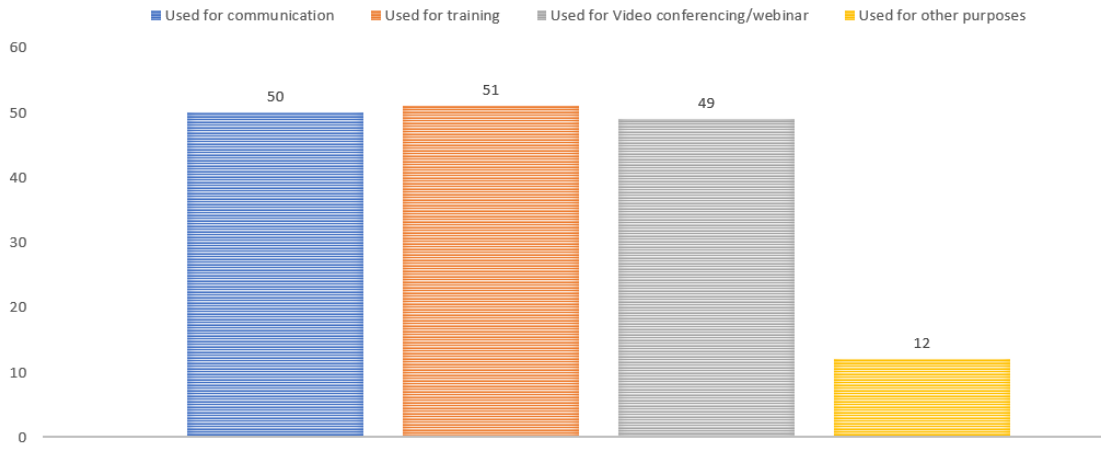


Figure 27- Question Nº 36 "What exactly are that platforms been used for?"

We are in a digital era, where both adults and children use social media and messaging applications for communication. Knowing the most used ones, can help in the training process as, we can take advantages of this apps, namely WhatsApp and Facebook, to apply microlearning (fig 28).

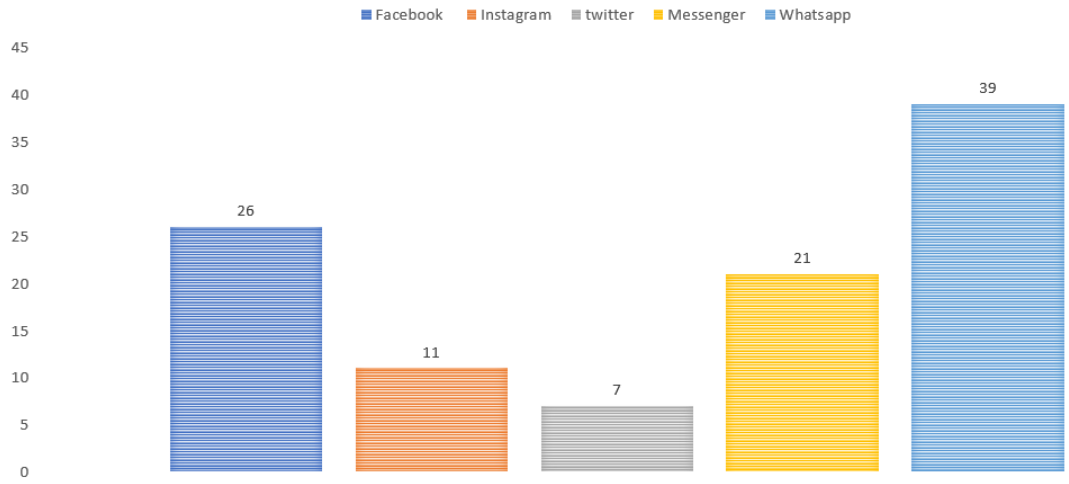


Figure 28- Question Nº 37 "Which social media and messaging apps do you used for communication?"

To end the survey, it was detected aspects that can be improve in term of education, for which it has to be paid special attention, being the most important the need to have practical demonstrations, more study options link with individually taught subject's needs, more regular tasks, better structuring of materials, more multi-media elements, correct use of Moodle, or other e-learning platforms (fig 29).

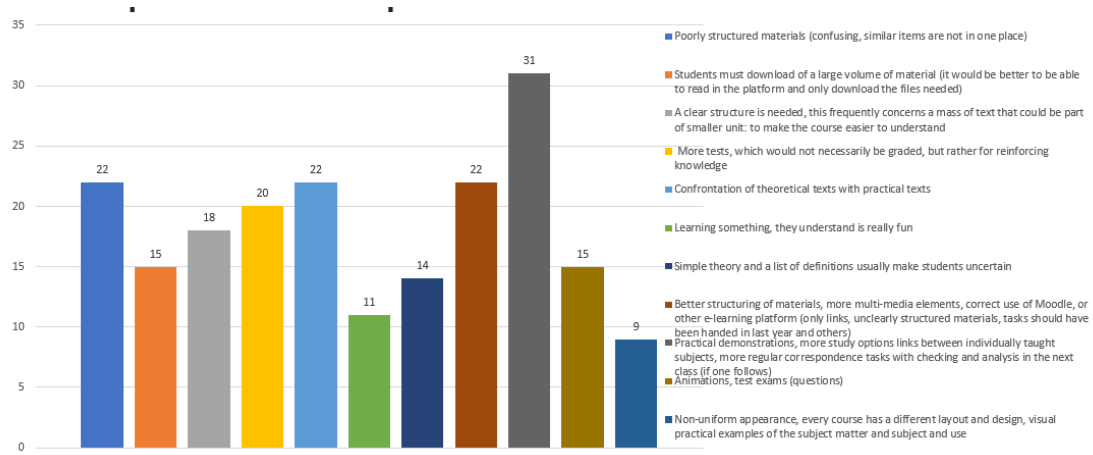


Figure 29 - Question Nº 38 "According to a survey made to students, the negative points of current e-Learning courses, or aspects to improve are (select the points that you agree)"

3.2 Conclusion of T2

The analysis of the second questionnaires, made with collaboration of high education teachers and vet trainers, allowed to conclude that having interactive resources, easy to use, with high quality and relevant contents, that are designed to address the needs of the learners, it can be obtain a better and fast learning process. Being the Microsoft team's platform, and the social communication tools WhatsApp and Facebook the most popular between HE teachers, which can foster a more active participation of the teachers in their learning process and suggests possible changes in pedagogical practices.

The society is being affected by digitalisation, with the internet providing unprecedented access to information and offering people exceptional levels of individualisation. However, this comes with significant risks of which 'fake news' is just one aspect. Such trends are having consequences for social life, citizenship and democratic participation that are only just starting to be appreciated and must be taken in consideration.

In HE and VET institutions there is a need for innovative responses in teaching, learning and organisation.

4 PR1.T3. Analysis of best digital training methodologies

This project results consist of an analysis of different training methodologies obtained through research and evaluating the main methodologies in use in the field of steel structures. This report starts with a state-of-the-art of to the cutting-edge digital teaching and learning techniques and tools for delivering innovative higher education and training in steel structures. A balance analysis was performed, with pros and cons being considered, to select the best methodologies for microlearning.

It is also aim of this task to evaluate the requirements on digital tools and digital training methodologies in the field of steel structures.

4.1 Introduction

This report envisages to make a collection of the best existing training methodology in the field of steel structures which potentiates the learning process.

Digital learning is increasingly influencing both classroom/campus-based teaching, but more import is leading to new models or designs for teaching and learning. However, for the training methodology in steel structures to be effective there are some aspects that should be considered, namely the content should be "learner centred, being the topics proposed by the trainer/teachers to which the learned can add extra contents/topics, according to their needs, roles and responsibilities in professional life. Skills, knowledge, and information should be provided to this end.

Additionally, the digital training methodology should meet some of the following requirements:

SEGMENTATION – the learning content should be segmented to facilitate the assimilation of new knowledge and allow flexible scheduling of time for learning.

ENGAGING CONTENT: Instructional methods and techniques should be used creatively to develop an engaging and motivating learning experience.

INTERACTIVITY: Frequent learner interaction is needed to sustain attention and promote learning.

PERSONALIZATION: Self-paced courses should be customizable to reflect learners' interests and needs; in instructor-led courses, tutors and facilitators should be able to follow learners' progress and performance individually.

4.2 Analysis of training methodologies

The pandemic was a milestone in the history of digital technology in several sector, particularly in education, allowing a sustainable learning environment, where in a few days a transformation has occurred from traditional classroom teaching to online teaching. Due to this scenario the use of digital learning was forced, and as consequence the methodologies that were easy to use and that were available at that time were the ones applicable, being or not most suitable ones.

Digital learning methodologies are new methods of teaching using technology with the purpose to improve the quality of education and involve participants in the educational process. Beyond e-learning as a means of asynchronous training from one's computer, in the next section it can be found an overview of the main existing teaching methods for digital learning (virtual classroom, game-based Learning, online learning, mobile learning, adaptative learning and Social Learning) with the correspondence strengths and weakness.

4.2.1 The virtual classroom

Based on the principle of traditional synchronous training, virtual classes allow trainers and learners to be brought together in the same virtual place, for example during a video conference.

Traditionally, the school has been the place where learners and teachers meet each other for the purposes of acquiring knowledge. However, with the advent of computer technologies in the early 1990s, many products and solutions have been developed to fully exploit the internet. Since then, virtual learning environments (abbreviated as VLEs) have emerged to supporting teaching and learning activities across the internet.

Table 1. strength and weakness of virtual classroom [15]

Strengths	Weakness
Increased convenience *It is undeniable that virtual classroom removed the limitation of time and location, a common challenge in a traditional classroom. With the uplift of these limitations, learners have the freedom to study and finish the coursework anytime, anywhere. Learners also have the freedom to engage with others on classroom topics, do the assignment, absorb class content, or take exams at a time or duration that best fits their schedule.*	The need for extra training *One disadvantage of virtual classroom is the fact that some trainers and students are not confident using digital e-Learning tools. Some instructors face challenges in acquiring and adopting the technology and most of them report technical problems. Besides that, some online teachers have problems preparing study materials in the soft format. This explains why it may be* ***necessary to have an IT support conducting training here and there.***
Effective time management *Learning online provides working class adults the ideal environment needed to balance between work, family, and the demand of going back to school. This type of classroom helps to manage time more effectively. Attending virtual classes at the comfort of the living room saves many hours that could otherwise be used to commute forth and back to classes on a campus.*	Infrastructural challenges: *Changes related to infrastructure are considered as one of the main disadvantages of a virtual classroom.* *Initial adoption of the technology needs massive and good network infrastructure. Although exists more affordable solutions, the cost of installing such infrastructures is extremely high and some institution might not afford.*
Improvement of digital skills *While increasing the skills and knowledge in the area of study, at the same time the digital skills are improved on some of the most sophisticated online learning solutions. with the learning progress in an online world, students will become highly productive and confident using interactive online learning tools: Meeting app, collaboration tool, teleconferencing solutions, and so on.*	
Affordable *The cost required to set up a classroom and distance learning management system compare are more favourable with the cost of building or expanding additional real classrooms to take up extra students. These savings can typically be passed onto the learners, where they are required to pay less of the school fees.*	
Immediate feedback on exams and tests *Getting instant feedback on exams and tests is another great advantage of virtual classroom. Exams, assignments, or tests taken online are usually scored as soon the learner finishes. This helps in tracking the progress of the student and it indicates weak areas for improvement.*	

4.2.2 Game-based Learning

Organised in various forms (simulation, gamification, etc.), they enable know-how to be learned in a fun and sometimes in collective way.

Table 2. strengths and weaknesses of game-based learning [13]

Strengths	Weakness
Draws learners into a lesson more actively	*Games take time to learn and design properly*
Competition can peak motivation	*Wasted efforts will be the greatest administrative fear for adult educators*
Improve learners' abilities while achieving interim goals that makes them feel like they are progressing	*It can involve materials that range from the inexpensive to the costly*
Reinforce the fact that failure is not a setback nor an outcome but indication that more skill building is needed	*Pedagogical and technical supports might be necessary (additional resources)*
Through discrete steps, learners can see the interrelationship of tactics and strategy.	
Learners gain an understanding of procedure and the value of alternative paths	
Game based learning helps learners become more confident, independent thinkers who are more prepared to take on large projects and carry them through to completion procedure and the value of alternative paths	
Game based learning helps learners become more confident, independent thinkers who are more prepared to take on large projects and carry them through to completion	

4.2.3 Online learning

The wide range of digital learning that is available online is highly diverse, ranging from individual pieces of content that might be used in single lessons with students, through to full courses being online digital learning ranges from learning resources that might be used by teachers and trainers in formal settings through to a vast and growing array of informal and non-formal learning opportunities posted by experienced (and sometimes not so experienced!) professionals on social media platforms. In this context it can be referred examples of two important courses (Massive Open Online Course and Small Private Online Course).

4.2.3.1.1 The MOOC (Massive Open Online Course)

The best-known teaching method, it is based on the use of a platform for training through videos, downloadable documents, quizzes, etc.

4.2.3.2 SPOC (Small Private Online Course)

Like the MOOC, this interactive training course has the particularity of being aimed at a smaller group of learners, which encourages interactivity with the trainer and ensures that learners are followed up.

Table 3. strengths and weaknesses of online learning [13]

Strengths	Weakness
Educators and learners can freely copy, use, adapt and share digital resources.	*Creation and maintenance of comprehensive open courseware (OCW) entails substantial initial and ongoing investments for personnel.*
Lessens the costs of producing and distributing course material	*The problem of decentralisation makes it difficult for teachers to determine the best free resources, and a lot of these repositories are not well organised which makes it harder for the resources to be discovered.*
Increases access to learning materials	*Financial sustainability, the ability of a project to continue its operations, covering the costs of producing and ensuring the capacity to use and reuse material can be complex.*
Opens up more possibilities for informal and non-formal learning	*If improvements are made, it is difficult to replace the original version of the content easily*
Can be reused and repurposed to meet specific needs.	*Educators face difficulties in repurposing Open educational resources (OER) within traditional pedagogical practices.* *Some authors have pointed to low overall completion rates in MOOCs*
Encourages lifelong learning	*Relying on user-generated content can create a chaotic learning environment*
Promotes and enables personalised learning	*Digital literacy is necessary to make use of the online materials;*
MOOCs are regarded by many as an important tool to widen access to higher education (HE) for millions of people (as long as they have internet connection) and can help to democratise content. They allow access to knowledge from universities all over the world, which was previously not possible	*The time and effort required from participants may exceed what students are willing to commit to a free online course;*
Providing flexibility in where and (often) when to access material, MOOCs facilitate personalised learning as well as lifelong learning.	*Participants must self-regulate and set their own goal*
MOOCs open up a wealth of new business opportunities, for example in terms of support services to create platforms	
By widening educational access at tertiary level, MOOCs are an important tool to achieve goal 4 of the 2030 Agenda for Sustainable Development.	

4.2.4 Mobile Learning

As the name suggests, this involves training from a smartphone. A practice particularly suited to the "anytime, anywhere, anyplace" learning experience.

Table 4. Strengths and weaknesses of mobile learning [13]

Strengths	Weakness
Relatively inexpensive opportunities as the cost of mobile devices are significantly less than PCs and laptops (decrease in training costs, textbook costs etc.);	*Depends on connectivity and battery life*
Able to access information and educational opportunities faster than other media;	*Screen size and key size*
Learners can access teaching material in different locations using portable devices	*Meeting required bandwidth for nonstop/fast streaming;*
Exchange of information can be encrypted or private;	*Number of files/asset formats supported by a specific device*
Multimedia content delivery and creation options;	*Reworking existing e-learning materials for mobile platforms*
Continuous and situated learning support	*Limited memory*
Access to personalised content	*Cost of investment vs risk of sudden obsolescence*
Remote and flexible access to knowledge, expanding opportunities for lifelong learning	*Flexibility also means it can lead to poor work-life balance*
Improved literacy levels	*Digital divide caused by accessibility and cost barriers for some end users;*
	Frequent changes in device models/ technologies/functionality etc.;
	Disruption of students' personal and academic lives
	Risk of distraction by other non-learning apps

4.2.5 Social Learning (social and collaborative learning)

Based on the exchange and sharing of experience within a group, this more informal and collaborative learning method is also used in a complementary way in the context of hybrid or face-to-face training.

The theory was created by Albert Bandura, he argued that people could learn new behaviours and information from watching others (also known as observational learning). The Social Learning Theory revolves around three concepts. The first concept is that behaviours and information can be learnt through watching others. The second concept is that internal mental, sub conscious, states are an essential part of this process. Lastly this theory recognizes that just because something has been learned, it does not mean that there will be a change in the persons' behaviour.

Table 5. Strengths and weaknesses of Social Learning [13]

Strengths	Weakness
It is a natural Way to Learn *The most significant advantage of social learning is that everyone uses it naturally every day, consciously and unconsciously.*	*Inner conflicts* *Since social learning is based on the idea of adapting what is perceived as successful and positive behaviour in other students are learning to behave more like someone else. If it is used this tactic too often and too intensely, it can result in inner conflict if the new behaviours are contrary to your own views. In the long run, this leads to active internal resistance and prevents any learning process*
Better skills *These tendencies are great for leverage in organisations. By encouraging sharing thoughts, ideas, experiences, and best practices, it will strengthen employees' productivity and skills.*	*Less authenticity* *In most cases, it would take long-term, repeated imitation to adopt a new behaviour as one's own or lose one's connection to one's personality. Moreover, people often notice it themselves when something doesn't feel authentic.*
Higher Learning Retention *It is scientifically proven that people only remember 10% from formal learning sources, while the remaining 90% comes from informal sources and social learning. By learning something directly from a person, it will be better remembered, because we remember things like voice pitch, images, memories, or even a joke during learning that we associate with learning content.*	*Loss of innovation* *Personal thought processes, opinions and views are often neglected, favouring behaviour that promises the greatest success. However, since new and unconventional ideas tend to bring progress and innovation, this learning technique should not be used too much.*
Lower costs *Bringing employees together to share subject matter expertise costs less than a seminar or learning content on the same topic.*	*Unexpected obstacles* *Very few people know their limits, strengths and weaknesses really well. It is often not possible to imitate the behaviour of another because unknown obstacles can arise. This can result in frustration, which leads to resignation.*
Productivity and sustainability *When employees know who to ask about a topic, the information spreads, and, over time, a mentoring network is created within the company. This encourages sharing and reduces the need to learn from other sources.*	*Self-doubt* *If everyone is a teacher and a student simultaneously, there is uncertainty about quality standards, and there can be self-doubt.*
Employee retention *Many employees want to continue their education, and they want to share ideas with colleagues. Social learning enables them to do both, creating stronger bonds with each other at the same time. That, and the awareness that the company allows or even encourages this type of exchange, increases loyalty.*	*Measuring requires modern solutions* *There are few ways to measure social learning apart from content usage unless you use a modern learning platform.*
Better informed *The more frequently employees exchange ideas with their colleagues on a wide range of topics, the more often they look beyond their horizons. This broadens their perspective and gives them impressions that help prevent mistakes and increase efficiency.*	*Negative assumptions* *Social media and videos are considered a waste of time and leisure time in many minds.*
Collaboration	*Requirements*

Learning is not the only thing that is collaborative in this case. Other factors are naturally included as well. Employees help each other more often, seek advice and help, collaborate better, and learn along the way. The best time to learn is when you need the knowledge.	*Attention, retention, replicability, and motivation must be present in each participant for it to work.*
Problem Solving in Real Time *Many employees are looking for learning opportunities in a moment of actual need. The urge to solve a problem they cannot solve on their own requires collaboration. Usually, the first thing humans will do in this situation is asking others for their ideas. This is much faster than searching for answers online.*	*Necessary intervention* *Group discussions need to be led because otherwise, they quickly digress and turn into random private conversations, losing focus on the topics at hand.*
Shorter Onboarding Times *Having colleagues showing around, answering questions, and providing the useful tips helps to get used to a new job and environment much faster than an online course on company culture or responsibilities.*	
Inclusion of Passive Employees *There are lots of people that are quiet or even afraid to ask questions. Social learning in a context of learning groups or any other group larger than 2 people make it easier for introverts to learn by listening to other people discussing their questions.*	

4.2.6 Adaptive learning

This concept refers to the ultra-customisation of certain training courses to adapt to the needs of each learner (specific modules and workshops, adapted training courses, etc.). with digital learning, the learner is not simply a consumer of content (that's e-learning), he or she is an integral part of a promotion and the success of a virtual training course, whether in the context of blended learning or 100% online, depends on the coherence and appropriateness of the combination of all these teaching resources.

Every learner has their own experiences, knowledge level, and skillset. (Almost) all modern learning platforms have a way to create adaptive learning paths.

Table 6. Adaptive learning weakness and strengths [12]

Strengths	Weakness
Training courses adapted to each learner *it makes it possible to personalize learners' training courses. It makes selections and refines its choices in real time, offering increasingly tailored content to each individual as it gains more data about them.*	*To maximise the potential of the platform, training managers and designers need to put a lot of effort into planning out courses. It requires the creation of suitable, high-quality adaptive learning content in multiple formats, including video and audio, as well as interactive elements. This can certainly prove complex, and it requires a strong understanding of how to use a variety of software.*
Higher retention rates, better results *it makes employees more likely to retain what they learn during the course and, in turn, helps them to develop new skills more easily. As such, adaptive learning is effective in promoting knowledge consolidation. Adaptive learning platforms can also jog learners' memories by offering them online materials, such as quizzes, at the end of their training course.*	*It needs to be integrated into a blended learning strategy, as without contact with others, learners are likely to end up feeling cut off and unmotivated.* *A common mistake, therefore, is to assume that adaptive learning can take the place of all other forms of training. Instead, it should be just one of the many tools, and form part of a broader digital learning strategy. Ideally, it should be used within the context of blended learning, in combination with face-to-face sessions and other forms of online content.*
An intelligent coaching system *Thanks to artificial intelligence, it's now possible to offer more comprehensive support to remote learners than ever before. That's because adaptive learning systems come complete with coaches, as well as other kinds of virtual tutors.* *These 'coaches' are, more accurately, chatbots, which are fuelled by data provided by the user. The more a learner communicates with their virtual coach*	*The team needs to be able to correctly interpret its results* *Adaptive learning systems generate a lot of data. The team should interpret and analyse it all—* *The adaptive learning platform might offer you a huge variety of graphs, statistics, and figures. It can become a bit overwhelming if students are not sure what to look out for!*

4.2.7 Summary of teaching mythologies

There are several teaching methodologies, each having advantages and disadvantages. Although, there is one weakness that is common to all techniques that is the need of training in digital technologies and the need to produce contents according to the learning method.

Theo Hug separated learning in three levels, which described the macro, meso, and micro levels of learning. Macro learning is seen as the larger topic being mastered—for example, a degree in chemistry. Meso is more of an intermediate unit, such as an Organic Chemistry 101 course. Meso learning could also relate to the lessons within a course because those also represent mid-level learning in context to the class itself. Microlearning fits in last, as the smallest unit of instruction possible.

Microlearning is a very effective method, for those who need training and don´t have enough time to study.

Microlearning should not be viewed as a replacement for other types of learning delivery, including classroom instruction, online learning modules, games, and simulations. Rather, it is part of a larger learning ecosystem. Microlearning should be used in conjunction with other delivery methods to ensure the participant's journey toward mastery or the desired behaviour is a success. It is not possible to expect one single method to meet every instructional need.

Microlearning can support the larger organizational learning ecosystem. In the corporate world, the macro level represents the strategic outcomes of the organization, the meso represents the departmental outcomes aligned to the overall organizational outcomes, and the micro represents the team's or individual employee's outcomes that map back to the departmental outcomes. Each of these levels of outcomes supports the overall goal [14].

4.3 Microlearning

"Microlearning is an instructional unit that provides a short engagement in an activity intentionally designed to elicit a specific outcome from the participant". Microlearning provide learners with bite-sized learning content that they can learn at their own pace.

It also allows them to focus on each topic without getting overwhelmed with new information

Microlearning has become one of the fastest growing trends in professional learning and development in the past decade. However, the **best uses of microlearning are when it is integrated into a larger learning design**. Microlearning **it's not meant for deep reflection or building expertise or systems knowledge or complex problem solving**. Skill development takes time and experience through contextual application, which microlearning is not designed to do.

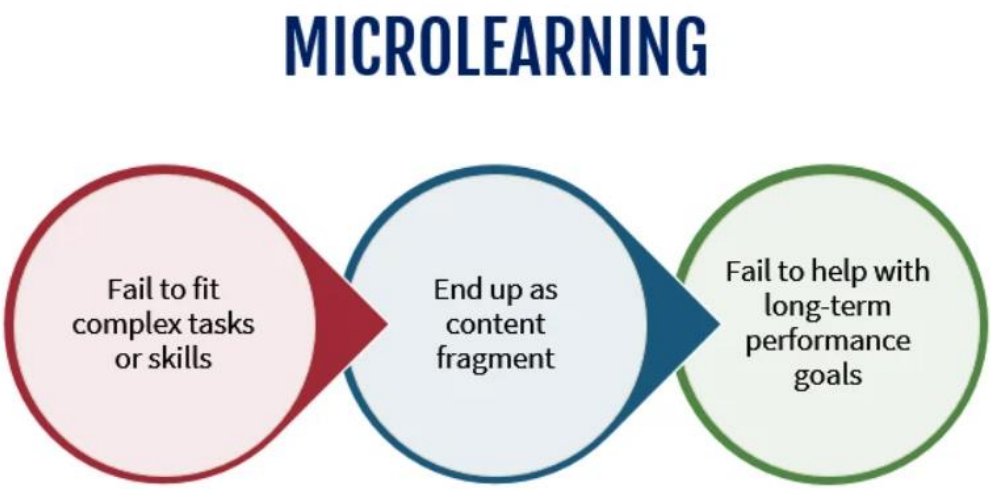


Figure 30 . weaknesses of micro learning [12]

Microlearning is any kind of short training module designed to achieve a specific learning goal. As the name suggests, it transmits small amounts of information that learners can take on in just a few minutes.

According to there exists a framework of six use types of microlearning, identify as following:

• **Pensive microlearning.** Use this type of instruction to ask the learner to reflect upon an idea, situation, or learning task. The goal is to have the learner think through or brainstorm ideas or concepts through reflective inquiry.

• **Performance-based microlearning.** Use this type of instruction to assist the learner in performing a task in the moment. It's also known as just-in-time or at point of need learning. If it is used a step-by-step how-to video to perform a household chore, it is called a performance-based microlearning.

• **Persuasive microlearning.** this type of instruction is used to modify the learner's behaviour. It gently reminds the learner of goals and prompts behaviourally focused actions. This type of microlearning is often used in exercise or wellness applications.

• **Post-instruction microlearning.** this type of instruction is used as a targeted follow up to a larger instructional event, such as a workshop or conference. It provides reminders and quizzes related to the key concepts from the larger training.

• **Practice-based microlearning.** this type of instruction is used as both a reminder to practice and a coach to help hone a skill. A good example of this is a language app on a phone— receiving reminders, tips, and practice opportunities all designed to help to speak a foreign language.

• **Preparatory/preparation or primary microlearning.** this type of instruction is used to set up a series of planned learning initiatives to prepare for a larger learning event such as a webinar or an all-day class session. This could be a refresher of content, or it could be new, general content [14].

4.3.1 Learning domain

When examining microlearning, it's important to consider the learning domain (table 7). To be able to perform the mental processing required by analytics/analysing, synthesis/evaluation, and evaluation/creating a great deal of time and effort is needed. These thinking processes are appropriate for classroom instruction, workshops, mentoring, and apprenticeships, not standalone microlearning.

Table7. Cognitive Domain Taxonomy [14]

Bloom's Term	Anderson and Krathwohl's Term	Combined Definition	Appropriate for Microlearning
Knowledge	Remembering	Demonstrate memorization of previously learned material. Focused on recall.	Yes
Comprehension	Understanding	Organize ideas, compare and contrast concepts, and summarize content and ideas.	Yes
Application	Applying	Apply previously learned knowledge to a situation.	Yes
Analysis	Analyzing	Examine and break information into smaller parts and determine relationships to make inferences.	No
Synthesis	Evaluating	Make a judgement related to a course of action or a set of criteria.	No
Evaluation	Creating	Combine elements together in a new pattern; create something original.	No

For microlearning in the psychomotor domain, the goal is typically not to have the person learn the skill or sequence of steps. Rather it is for the person to perform the sequence of steps at a high enough level to complete the task. Sometimes this is referred to as the "guided response" level of a psychomotor taxonomy, or the imitation level.

Table 8 - Psychomotor Domain Taxonomy [14]

Dave's Term	Definition	Appropriate Use of Microlearning
Imitation	Observing and copying someone else. Most likely a video or animation of a physical process.	Yes
Manipulation	Attempting the physical manipulation of tools and equipment guided via instruction to perform a skill.	Yes
Precision	Demonstrating accuracy, proportion, and exactness in the skill performance without the presence of the original source.	No
Articulation	Combining, sequencing, and performing two or more skills consistently.	No
Naturalization	Combining, sequencing, and performing two or more skills consistently with ease, little physical or mental exertion, or automatically.	No

The learning materials will be used to [*choose one*] the training initiative.	☐ Supplement	☐ Reinforce
	☐ Augment	☐ Remediate

Use Case	Design Considerations	Contextualized Example	Possible Measures
Why do you want to use it? What's the purpose?	**Learner**	Who are you targeting?	What's the desired performance?
	Content	What subject matter do you want to cover?	
	Content Access	Where do you want to include it? When do you want to incorporate it?	
	Development	What modalities (auditory, visual, etc.) do you want to include?	

Figure 31 - Microlearning Use Case Design Worksheet [14]

4.3.2 Things to look at to guaranty the success of microlearning

Shrunken head learning. Forcing someone to go through a microlearning course originally designed for a longer, more in-depth format is a recipe for disaster. For example, you can't simply chop up a one-hour course into five-minute increments and

then shrink the training interface down to fit onto a smartphone. When you do this, all the outcomes of the one-hour course are still in place, whereas a true piece of microlearning would have only one outcome per activity or event. Creating an effective microlearning experience is a significant undertaking. A great deal of upfront planning to determine the right design and delivery for the microlearning experience is necessary for optimal success.

So, to stablish a microlearning methodology some points/requirements should be carefully followed:

1. Should be an instructional unit. An instructional unit is a start-to-finish learning or performance-enabling experience. Everything the participant needs is contained within the unit. It can be a learning activity, a video, a text message, work instructions, a performance prompt, or a flash card. One entire piece of instruction provides all the elements necessary to achieve the desired outcome. In other words, it stands by itself.
2. Should promote short engagement. In microlearning, the experience is not meant to last beyond a few minutes. The exact number of minutes is not universally agreed upon. We've seen the timeframe for microlearning defined as a few seconds or as long as an hour. So, *a one-size-fits-all time constraint doesn't work*. Naturally, different learning or performance needs require different lengths of time. The goal of the microlearning experience should **be focused on achieving a singular outcome**.
3. Should promote Engagement. Without some type of engagement or a method to hold the participant's attention, the value of microlearning is lost. Engagement occurs when the participant's attention is tuned into the microlearning event, and they voluntarily agree to take part in the microlearning. Engagement can take the form of gamification (forced engagement), a buzzing or beeping emitted from an educational app (sensory engagement), or the participant's desire to "need to know" during the flow of their work (self-prompted engagement).
4. Should promote Activity. Passively watching a video or absent-mindedly reading a message does not create an activity or lead to a desired outcome. The learning or performance improvement portion of microlearning is a direct result of some type of action or activity being evoked. Research is clear that most knowledge gains occur when a person is involved in an activity to reinforce the learning. The activity might

be as subtle as a mental activity, “consider three options for solving this problem,” or as a physical activity, “take the wrench and twist the bolt in a clockwise direction to tighten.”

5. Should be Intentionally designed. Cutting up an hour-long course into five-minute pieces and calling it microlearning will not produce the intended learning outcomes. The process of designing microlearning **must be intentional or the desired outcome** may not be achieved.
6. Should Determine a specific outcome. One of the first things that should be considered when designing microlearning is to determine **what the outcome of the microlearning** should be—for example, to pass a test, properly assemble an item, or act or behave in a certain way. The product’s design should then help to facilitate that specific outcome, which would be less likely to occur without the learning program.
7. Should include Participants. The term participant best captures the fact that the person participating in the microlearning event may successfully assemble a bicycle when the event is completed but may not have stored the exact steps to do so in long-term memory. In essence, microlearning is not just about learning. In fact, many instances of microlearning **are focused on performance**—what the participant is going to do because of the microlearning experience [14].

4.3.3 Microlearning Strategy

Microlearning strategy comprises these three core concepts:

1. mapping outcomes
2. motivating the learner
3. delivering through an appropriate modality.

4.3.3.1 Making a Microlearning Map

When considering the development of a microlearning strategy, it is necessary to determine where microlearning fits into the overall curriculum. Whether academic or work-related, the curriculum has similar characteristics, which include a learning goal or intent:

- a concentrated subject matter area

- a path through the content that builds knowledge or skill acquisition in a logical order
- a learner profile that embodies various characteristics of the targeted group for instruction
- selected instructional strategies and activities, given a chosen theoretical framework, because multiple theoretical approaches can be incorporated
- an identified environment and materials
- methods for evaluation
- revision upon analysis of presented data from the evaluation.

Comprehending the curriculum allows to see the potential use cases for microlearning.

Table 9. Microlearning Map for a Bridge Inspection Course [14]

Department: Testing and Control		**Job Position: Civil Engineer I**
KPI Group: 1.0 Quality Assurance		Indicator: 1.1 Accuracy and Speed
Task	**Performance Criteria**	**Objective (no more than 3)**
Inspect a bridge to ensure it meets three critical seismic design criteria.	Given an image of a bridge on the computer screen, the learner will be required to pass or fail the seismic design elements of the bridge with 100% accuracy in 7 minutes.	• Recall the three evaluative criteria. • Recognize if a bridge element should be accepted or rejected.
Intended Use: Reinforcement		

Table 10. Microlearning Map With Motivational Element [14]

Department: Testing and Control		**Job Position: Civil Engineer I**	
KPI Group: 1.0 Quality Assurance		Indicator: 1.1 Accuracy and Speed	
Task	**Performance Criteria**	**Objective (no more than 3)**	**Motivational Element**
Inspect a bridge to ensure it meets three critical seismic design criteria.	Given an image of a bridge on the computer screen, the learner will be required to pass or fail the seismic design elements of the bridge with 100% accuracy in 7 minutes.	• Recall the three evaluative criteria. • Recognize if a bridge element should be accepted or rejected.	Make the application of the three criteria into a timed game with seven elements the learner needs to find.
Intended Use: Reinforcement			

There are several methods for delivering instruction, including gamification, short sims, and infographics. It's also important to note that often the motivational aspect (such as a game) overlaps with the method, which can also be a game. But regardless of specific

method, it's about understanding the characteristics of each method and evaluating how they will assist or limit opportunities to motivate the learner. A particularly broad way of looking at microlearning methods is to consider formal versus informal or push versus pull delivery (see table 11) [14].

Table 11. Comparing Formal Versus Informal [14]

Formal Learning	**Informal Learning**
Goals are set by someone else.	Goals are individually based and individually guided.
Learning is available only during fixed times. The learning content is pushed to the learner.	Learning is available 24/7. The learner accesses or pulls the content when they want it. They seek information or content in manners that work for their way of learning.
The content is structured for the learner by someone else.	The learner creates a structure and works toward gathering information to fit that structure.
Content is developed and distributed by someone else or delivered by a professional as opposed to a peer.	Content and information are gathered from peers. The learner and their peers share their know-how among themselves.
The content is consistent in message and validated for accuracy.	The content and information are unpredictable. The accuracy, level of credibility, and relevance of the content are not controlled.
Learner must determine how to best learn the material as opposed to selecting the learning methods they know will work best for them.	Learner adapts to the content by creating their own learning environment.
Learning is typically scheduled, or time needs to be set aside to engage with the content. This can take away from other work.	Learning is usually organic, occurring when time is available or at time of need. Learning can happen every day if the learner chooses.
Costlier to develop.	Usually, inexpensive.

Table 12. Microlearning Map with Learning Method [14]

Department: Testing and Control		Job Position: Civil Engineer I		
KPI Group: 1.0 Quality Assurance		Indicator: 1.1 Accuracy and Speed		
Task	**Performance Criteria**	**Objective (no more than 3)**	**Motivational Element**	**Method**
Inspect a bridge to ensure it meets three critical seismic design criteria.	Given an image of a bridge on the computer screen, the learner will be required to pass or fail the seismic design elements of the bridge with 100% accuracy in 7 minutes.	• Recall the 3 evaluative criteria. • Recognize if a bridge element should be accepted or rejected.	Make the application of the 3 criteria into a timed game with 7 elements the learner needs to find.	• Informal • Game
Intended Use: Reinforcement				

4.3.4 Evaluation

The four levels of evaluation model help measure the effectiveness of learning products. The first level of evaluation features self-reported data from the learners, and the model expands on that reporting up to the fourth level, which focuses on the return of the training initiative toward departmental or organization outcomes. Table 13 is a quick look at the four levels [14].

Table 13. Quick Overview of the Kirkpatrick-Katzell Four Levels of Evaluation [13]

Level of Evaluation	Description	Examples
1.Reaction	What does the learner think about the training immediately upon taking or participating in it? Input can range from how appealing the learner found the content to the pace to whether the learner thought they learned something to whether the learner thought the material was easy to understand.	• Post-workshop survey • Rating on a help page (how helpful was this article) • Focus group discussions
2.Learning	Did the learner pass the test and demonstrate knowledge acquisition? This evaluation level occurs as part of the overall learning initiative, whether at the end of all information being presented or throughout. This is where assessments ascertain if the learning objectives were met by the audience.	• Multiple choice, true/false, fill-in-the blank, essay-style exams • Rubrics (e.g., when evaluating a presentation, sales calls, or handling conflict in a team setting) • Simulations (e.g., land plane on water)

3.Behavior	Is there evidence of the learned content in the workflow or work performance? After a learner passes the test, this evaluation level measures whether they are actually using the information in practice. This can occur within days, a few weeks out, or even months later.	• Survey to the learners (more in depth than Level 1; these questions help gauge the amount of knowledge or skill being recalled and/or applied to job tasks) • Survey to the learners' managers • Review of job performances • Visual observation
4.Results	Is there evidence that the initiative is closing the gap on the known issue? Like a gauntlet, this is the largest hurdle to get across. This level means proving that the learning program is affecting the bottom line.	• Baseline data on the issue compared with post-learning initiative data • Performance of the individual (annual performance review) • Other markers your organization has identified as success indicators

Combining the evaluation plan questions with the Kirkpatrick-Katzell evaluation model it can be seen how an effective evaluation plan can be put into action (Table 14). It should be noticing the worksheet begins with the identification of what is being evaluated. This might seem like common sense, but often an evaluation plan is thrown off because people have different expectations of what is being evaluated. Having it in writing ensures that everyone is focused on evaluating the same element. It should also be noted that the training itself is not being evaluated but the outcome of the training, which is the accuracy of the reports. Measuring the effectiveness of microlearning means measuring outcomes that matter to the business.

Table 14. The Kirkpatrick-Katzell Model in Action [14]

What is being evaluated?	The type, accuracy, and quantity of compliance reports submitted
Why is it being evaluated?	• Several issues have gone unreported, creating operational issues for the organization. • Reports are also lacking in essential details that assist the compliance department in making determinations on whether or not to report. • Managers and leadership do not always know how to assist employees with compliance-based issues.

Level	Who?	Where?	When?	How Will You Evaluate?
1 Reaction	Learner	Online	Right after each piece of microlearning is provided	• Survey, using a star-rating system
2 Learning	Learner	Online	During each lesson (self-check) and at the end (mastery)	• Video-based scenarios with multiple choice questions • Role play to complete a report given a circumstance • True/false and multiple choice on basic compliance concepts
3 Behavior	Learner	Online	1 month and 3 months after taking microlearning topic	• Survey using yes/no, Likert, and open-ended inquiry questions • A few assessment questions on the main objectives of the topic
	Manager	Online	1 month and 3 months after employees took the microlearning topic	• Survey using yes/no, data entry, and open-ended inquiry questions • An upload option for reports that were submitted that quarter • A few assessment questions on the main objectives of the topic
4 ROI	Manager	Online	6 months and 12 months after the last microlearning program was deployed	• Similar survey to the one provided in Level 3, but with additional data entry points for cumulative data

4.4 Conclusions

Microlearning or bite-sized learning is perfect for this today's fast world of mobile learning and tight schedules. It gives you concise, accessible, and need-to-know information in the moment of need. Despite that, it's essential that you limit its use where it's most effective. Don't overuse or misuse it.

Microlearning is not meant to replace a whole learning system; it is meant to be used as part of one. You'll typically find it integrated at the lowest level of learning.

It is important to create a plan to implement microlearning into the learning initiatives and start the process. It is also crucial to design engaging, exciting microlearning pieces focused on the desired learning outcomes.

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