# ASYNCHRONOUS MICROLEARNING EXPERIENCE IN INDUSTRIAL MANAGEMENT MASTER COURSE

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## Abstract

This article introduces an initiative aimed at improving university-level education, carried out in the context of the Erasmus Plus IE3 project and focused on the renewal of courses in an industrial management master, driven by the need to incorporate new technological aspects, such as digitalization and Industry 4.0. The intention was also to promote a methodological change in the learning process by focusing on practical project development, paying special attention to the needs of a whole new generation of learners and their particularities. This analysis is based on papers presented at previous INTED conferences that created the competency framework and methodological approach.

The paper provides added value by discussing the integrated implementation between theoretical and practical aspects when learners must cooperate with students who do not participate in the course to complete industrial projects. Furthermore, the authors assess both the theoretical knowledge acquired by the learners and their practical performance, while also considering the relationship between them. The learners' perspective, gathered through video testimonies and surveys, is significant, given that they are participants in the education, and serves to point out possible strengths and weaknesses of the initiative, with the aim to further improve this approach.

Based on the elements introduced, the methodology and collected results, some conclusions will be formulated to assess the proposed approach, as well as to identify improving vectors to be considered. Recommendations will also be made in the context of the IE3 project will also be formulated.

Keywords: Microlearning; Asynchronous Learning; Industrial Management Master; Learning Assessment.

## 1   INTRODUCTION

Today, Generation Z students (people born between 1996 and 2012), fill university classrooms, and campus programs. Although not everyone born in a generational period shares the same values or experiences, they do share a common context that shapes their world view [1]. Thus, generational research can provide valuable information to design effective policies, programs, and practices for relevant stakeholders of the higher education system.

Gen Z has been raised with technology easily accessible; however, the level at which technology has been incorporated into their daily lives has been unlike that of any prior generation. The majority considered formal education to be very important and wanted to obtain university degrees. When it comes to career goals, around 50% placed autonomy, leadership opportunities, dedication, creativity, and self-employment high on the priority list [2].

The observed change in values concerns not only the interactions against the higher education system, but also the labor market. Any organization seeking to recruit, engage, and retain these generations will be hard-pressed if they do not incorporate emerging social and digital technologies into the workplace. Communication and collaboration with colleagues are not only a key driver of Millennial satisfaction on the job, but also a factor in their ability to do their best work. Gen Z, unlike Millennials, highly assesses independence. This can pose a challenge to companies that value collaborative skills of their

employees, as it is evidenced that Generation Z members will find it more difficult to teach many soft skills than current workers [3]. However, as we are mainly concerned about higher education aspects, and our working environment is closer, we are participating in a European Funded Erasmus+ project (IE3) looking to accommodate education scenarios to consider new digital paradigms and the profile of new learners.

A critical aspect to consider is the new attitudes from learners, expressed through different studies, telling us that Gen Z are primarily observers: They have a strong affinity for seeking information through video. "*To learn something, I prefer to watch someone do it correctly, then make an attempt to do just the same, if I don't understand something or if I need to watch something to help me ... I will look it up on YouTube.*" [4].

Within the IE3 project, several proposals have been presented to renew master programs in the field of industrial management, to consider the digitalization era, coined under the "I4.0" or Industry 4.0 acronyms, including a methodology proposal to implement a module renovation continuous improvement process of module renovation. Indeed, within the same project, we have had the opportunity to further research alternative learning methodologies according to the considerations about new learners. The most promising methodology was presented in the previous year's conferences [5], [6].

In this paper we aim to present the main results obtained from the practical application of the proposed approach. In Section 2 a very short summary of the proposed approach is presented. In Section 3 the context of the application is provided, and the main results are presented in Section 4. Conclusions will be the last Section of the paper.

## 2   METHODOLOGY

As presented in previous papers [5], [6] the innovative methodology involving digital tools for higher education in general and for industrial engineering and management (IE&M) in particular, which can achieve better alignment with the demands of the new student, is based on competency models. It allows the main characteristics of the learning process such as Anytime, Anywhere, Personalised Learning, and Flexible Discovery.

The approach at the module level for designing or implementing a course of an academic program will be to use the adopted skill process model (competency model) as a template. The main subprocesses of the metaprocess that describe the competence will be transformed into learning activities. Then, a second step is to instantiate the template with terms belonging to the application domain. These terms will be defined, described, and then their understanding or capability to be performed will be measured. The learning activities have been configured through a Knowledge Graph (KG) of microlearning pieces of information. Then, the KG was established, involving several columns. The first column represents the knowledge area, in close relationship with the competences to be mastered, and then the triplets are configured. The second column is the main subject of the concept, the third one reflects the linked subject, and the second columns explain the relationship working as a link between those two subjects.

For each of the graph entities as well as for the relationships, specific microcontent is provided, trying to offer in all the cases textural and visual information to facilitate knowledge acquisition. Indeed, set of questions is provided to test the knowledge before or after being exposed to the concepts. To use additional tools, the KG can be represented as a network.

The main reason for microlearning is to facilitate concept acquisition for Z Gen members, as visual teaching such as tik-tok, youtube, etc., shall be one way but not the exclusive one. To organize concepts and relationships, a complete competence structure needs to be provided. Competencies describe the level of understanding or proficiency of a learner in certain subject-related skills [7]. On the other side, competency-based learning or skills-based learning, refers to systems of assessment and grading where learners demonstrate these competencies. The next step to implement a proper microlearning context is to generate different learning artefacts, including concept and relationship explanations, as well as some exercises that can demonstrate gaining enough insights.

It was decided to use the classic Learning Management System (LMS) as a convenient tool to implement the Competence framework, and Moodle was selected for this purpose, where its different entries are grouped under the taxonomy keyword [8]. It looks to define every framework row, by setting the language string keys used to describe the competencies at each level of the framework [9]. Combination of skills will provide integrated perspective in a higher level, named competency. Finally, competencies are organized by domains of knowledge [10].

Another central aspect of the proposed methodology is to promote a balanced configuration of synchronous and asynchronous activities, as well as individual and social behavior, to better connect with some other characteristics of the targeted learners, as they also exhibit social behavior but also individualism for learning patterns and experiences [11]. If combined properly, can make the difference against more classical courses, in particular when new generations are targeted, as they are also concerned with applicability of the university time and opportunities after college.

## 3   APPLICATION CASE

To present specific ways of implementing transformed IE&M courses, a project management module was selected. An educational competence-based approach has been established, and an operational implementation way involving the microlearning concept has also been created.

Preparing learning experiences to emphasize shared learning, to be developed at least partially in classrooms, strongly depends on the topic and the practical capabilities being mobilized. In our particular case, for different project contexts, they are connected to the following topics:

– Project Methodologies.
– Project Scope.
– Project Schedule.
– Project Cost Plan
– Risk Management.
– Quality Management.
– Evaluation of project development
– Crisis Management, when different issues happen.

For the theoretical scaffolding, microlearning content is developed for each of the elements as well as for the relationship themselves, in such a way each learner can define their own path, having the opportunity to jump into the concepts and relationships according to their needs, having the opportunity to assess their level of gathered knowledge.

By following the same approach, when a single competency is selected, different skill entries become relevant. Just as an example, when project agents are selected as competence, relevant skills are identifiable, such as,

– Understand the value creation for project manager as well as their typology,
– Understand the relevance and responsibilities for all the legal entities around the project,
– Understand the work for different contractors as well as their relationship,
– Understand the implications for the project owner / product owner,
– Understand the project engineering roles and responsibilities,
– Understand the team work involved in both, project execution and project management.

This structure can be realized by defining the definition of the competence framework within the LMS. In the present case, the adopted taxonomy organizes the knowledge in four layers, where the concept is the atomic item and the skill is the capability of getting concepts working together, either for knowledge or just when used by a specific tool to carry out detailed outcome.

The methodology highlights a careful design of synchronous and asynchronous actions, but also because of the way Gen Z learns, the main driver for the course is the practical actions properly grounded and assessed. Inside the project management course, practical work is always challenging because part of the learning process requires dealing with dynamic behaviour, and it is hard to emulate. To overcome such a difficulty, a practical environment was brought, involving teams of undergraduate students in charge of the development of basic engineering. All the management aspects will be in charge of the master students. These learners will apply the concepts of project management consumed from the theoretical context through microlearning as the source of diagnosis and actions. In this context, the instructors play a relevant role as they act as sponsor as well as an independent technical consultant to help projects move forward.

With this configuration, the practical project development can be seen as a "*live lab*" where different situations can be created, experienced and managed with the capability to diagnose, analyse and react with different measurements.

In the present course, ten teams have been configured under this continuous assessment modality, with different project management methodologies for the different project mandates, where each management team involved around seven students as the number of participants was seventy-one. The course took place between September and December 2022.

## 4 RESULTS

The assessment procedure took care of the different quizzes designed for every microlearning concept, but also of the theoretical concepts managed in the practical work, as well as the practical activities carried out both, by the team as a whole and by the individual members. Such practical work has had a strong dynamic behaviour as they come from the real life. Feedback and theoretical discussions were held during the synchronous sessions. In Figure 1 the theory and practice scorings are presented, where it becomes clear that theoretical knowledge acquisition does not guarantee timely adoption of the right actions in practical work.
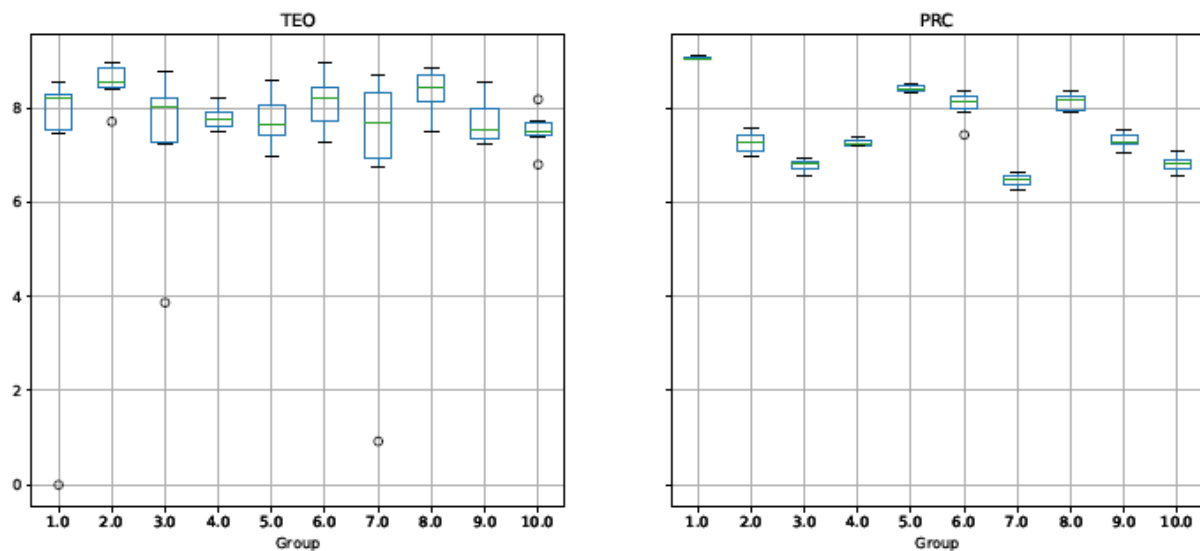


*Figure 1.- Videos created by teams (presentations) and by single members to describe their activities.*

A survey for which participants of the study voluntarily agreed and gave informed consent to their participation was conducted to collect the learners' opinions about the course and the methodology. All data from the survey was anonymised before publication. The raised questions are:

- Q1.- With this course, have you acquired valuable knowledge useful in the labour market? (0:Not at all / 5: Excellent)',

- Q2.- Compared to classical methodologies, I appreciate the one used in this course: (-5: The best is the classical / 5: Best this one)',

- Q3.- I prefer the short media content instead long readings or lectures to present concepts (-5: Preferred long readings or lectures / 5: Preferred Short Media Content)',

- Q4.- I prefer asynchronous learning of theoretical contents (blended learning) and use synchronous for discussions / teamworking) (0: Not preferred at all / 5: Fully supported)',

- Q5.- Regarding the practical assignment, I appreciate how it helps to implement Project Management: (0: Strong disagree / 5 Strong agree)',

- Q6.- I am happy with my performance in this course and the provided takeaway (0: Not at all / 5: Excellent)'

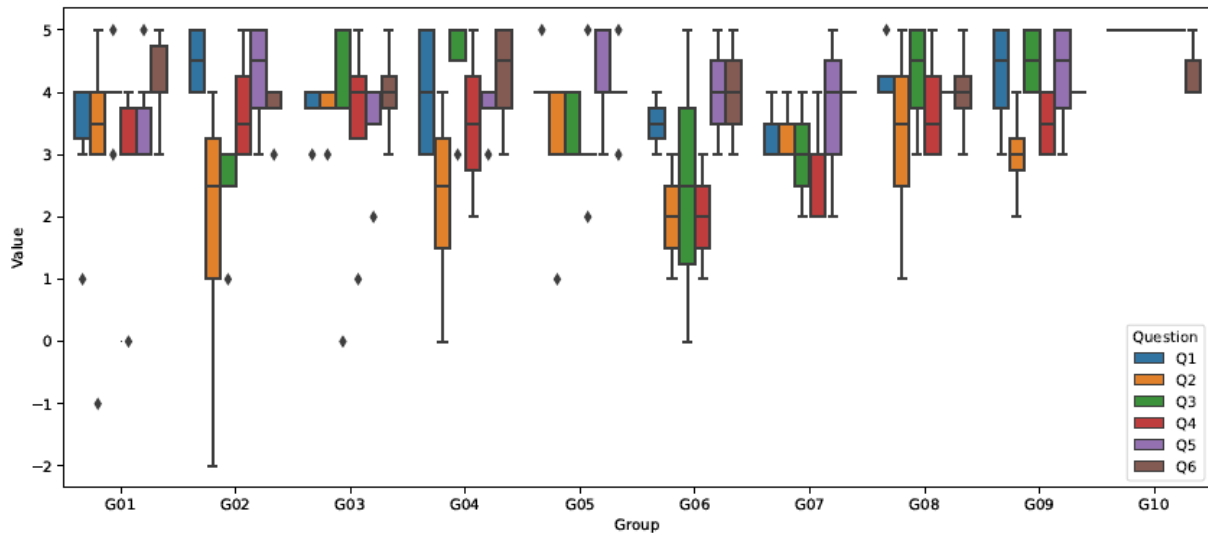The learners' opinion was summarized as per team and question in Figure 2,

*Figure 2.- Summary of the opinion of the participants in this revamped PM course.*

The assessment involved additional dimensions, such as communication skills, both as a team and as individual presentation of contributions, whether both are required from participants (see Figure 3) and where feedback can be easily provided. Indeed, it becomes easier to run a 360 degrees' assessment, allowing team members to give their opinions on both the content and the presentation of teammates.
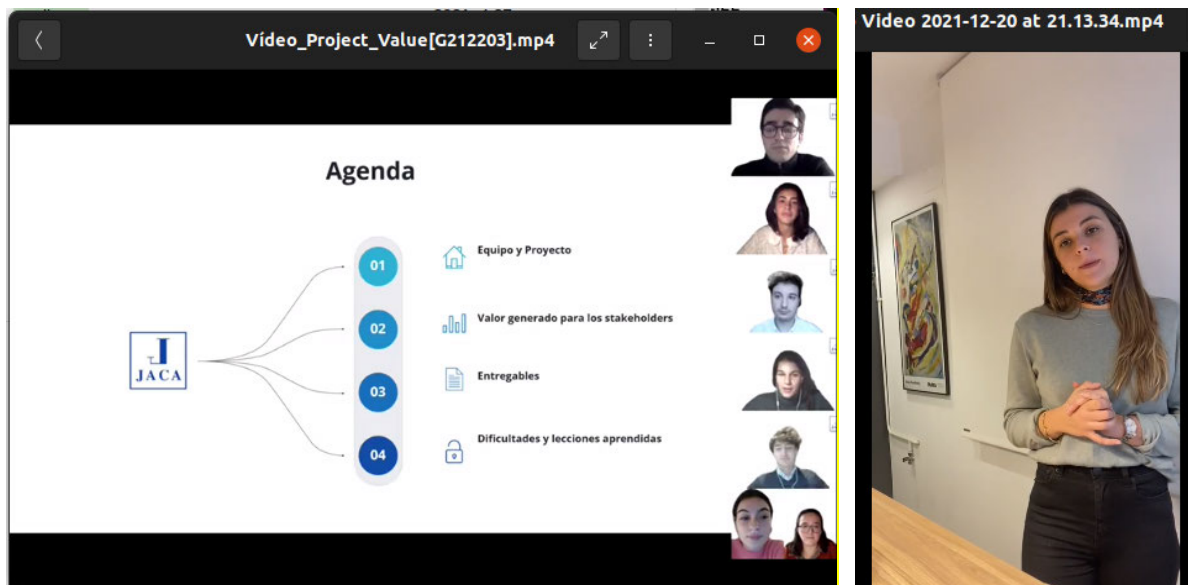


*Figure 3.- Videos created by teams (presentations) and by single members to describe their contributions*

## 5    CONCLUSIONS

On the basis of the current experience, several types of outcome have been identified. The first one is that digital technologies can help the learning process in different ways the learning process. Such ways included not only the content level, but also to improve peer-to-peer assessment. Indeed, it becomes a natural way to check the learners' communication skills.

Another clear conclusion is that in general learners appreciate the way this course was conducted, where the asynchronous blended solution was adopted to gather basic concepts, while discussions were used to clarify doubts or case-based situations. All in all, it was possible to identify a few learners willing to return the magisterial methodology instead of the more participative one, although it was just detected in a few groups.

It was also possible to confirm that learners prefer short video media content to gather knowledge, rather than reading documents or attending long presentations.

It was confirmed that Gen Z learners want to learn by doing, so they appreciate the practical assignment as the natural way of the learning process.

Initial experiments have been introduced during synchronous sessions through gamification (by using kahoot® tool) to check the degree of penetration of the theoretical knowledge gathered. However, although promising, better integration within the adopted methodology is required. Such activities will be configured for the next releases of the course.

Additionally, international students (G10) are much more homogeneous and they better appreciate the participative methodologies.

As a takeaway for the IE3 project, it becomes clear that it is not just a matter of content renewal, but also of incorporating digital tools and solutions, while the courses shall incorporate practical work allowing participants to do things and assess the outcome. Indeed, to work in large teams is challenging for Gen Z learners, therefore, additional skills need to be constructed by means of different experiences.

## ACKNOWLEDGEMENTS

## REFERENCES

[1]     M. Sakdiyakorn, M. Golubovskaya, and D. Solnet, "Understanding Generation Z through collective consciousness: Impacts for hospitality work and employment," *Int. J. Hosp. Manag.*, vol. 94, p. 102822, 2021.

[2]     D. Schwieger and C. Ladwig, "Reaching and retaining the next generation: Adapting to the expectations of Gen Z in the classroom," *Inf. Syst. Educ. J.*, vol. 16, no. 3, p. 45, 2018.

[3]     B. Chillakuri and R. Mahanandia, "Generation Z entering the workforce: The need for sustainable strategies in maximizing their talent," *Hum. Resour. Manag. Int. Dig.*, 2018.

[4]     C. Seemiller and M. Grace, "Generation Z: Educating and engaging the next generation of students," *About Campus*, vol. 22, no. 3, pp. 21–26, 2017.

[5]     J. Ordieres-Meré, G. M. Alonso, and M. Gutiérrez, "COMPETENCE ORIENTED AND KNOWLEDGE GRAPH BASED APPROACH FOR INDUSTRIAL ENGINEERING AND MANAGEMENT EDUCATION IN THE NEXT FUTURE," in *{INTED}2021 Proceedings*, 2021.

[6]     J. O. Szłapka, M. Ortega-Mier, J. Ordieres-Meré, F. Facchini, G. Mossa, and J. Lundquist, "INNOVATIVE METHODOLOGIES AND DIGITAL TOOLS FOR HIGHER EDUCATION IN INDUSTRIAL ENGINEERING AND MANAGEMENT," in *{INTED} Proceedings*, 2020.

[7]     R. Whitley, "Developing innovative competences: the role of institutional frameworks," *Ind. Corp. Chang.*, vol. 11, no. 3, pp. 497–528, 2002.

[8]     E. Stefanova and N. Nikolova, "Designing a Competence-Based Learning Course with Digital Tools in Higher Education," *Trends Appl. Inf. Syst. Technol. Vol. 3*, p. 202.

[9]     M. Then, B. Wallenborn, M. Fuchs, and M. Hemmje, "Towards a Domain Model for Integrating Competence Frameworks into Learning Platforms," *Formamente-International Res. J. Digit. Futur.*, no. 2016/3, p. 4, 2016.

[10]   K. Rezgui, H. Mhiri, and K. Ghédira, "Extending Moodle functionalities with ontology-based competency management," *Procedia Comput. Sci.*, vol. 35, pp. 570–579, 2014.

[11]   M. Roszak, I. Mokwa-Tarnowska, and B. Kołodziejczak, "E-learning Competencies for University and College Staff," in *Universities in the Networked Society*, Springer, 2019, pp. 185–200.