

09-012

MICROLEARNING AND KNOWLEDGE GRAPH BASED APPROACH FOR TRAINING IN PROJECT MANAGEMENT.

Ordieres Meré, Joaquín ⁽¹⁾; Miguel, Gutiérrez ⁽¹⁾; Gustavo, Morales-Alonso ⁽¹⁾

⁽¹⁾ Universidad Politécnica de Madrid

New generations currently attending university courses exhibit specific behaviour, not observed in earlier generations, as the result of being exposed to internet and social media tools from the beginning. To configure more efficient learning procedures is a requirement, but this behaviour can be identified as well as to professionals looking to enlarge their knowledge. The goal of the paper is to present a new competence oriented educational configuration. Microlearning combined with the knowledge graph representation as well as an advance competence approach enabling embed assessment of knowledge related to both nodes/concepts and arcs/relationships.

Keywords: Project management; learning generation Z; competence based educational model; education-oriented knowledge graph; new approach to higher education.

MICROFORMACIÓN Y GRAFOS DE CONOCIMIENTO PARA FORMACIÓN EN GESTIÓN DE PROYECTOS.

Las nuevas generaciones de universitarios presentan comportamientos específicos no observados con anterioridad en las pasadas generaciones., principalmente debido a su exposición a internet y a las herramientas de las redes sociales. Formalizar procedimientos de formación más eficientes para estas generaciones es un requisito esencial, dado que esos comportamientos ocurren también en el mercado de trabajo, donde los profesionales también buscan expandir sus conocimientos y capacidades. El objetivo del artículo es presentar una nueva configuración formativa basada en microaprendizaje y competencias. El microaprendizaje combinado con una representación basada en un grafo de conocimiento, así como una orientación a competencias con validación de las mismas por cada elemento de conocimiento o por cada relación entre elementos de conocimiento.

Palabras claves: Gestión de proyectos; aprendizaje en la generación Z; modelo educativo basado en competencias; grafo de educación orientado a la educación; nuevas aproximaciones en educación universitaria.

Correspondencia: JOAQUÍN ORDIERES MERÉ j.ordieres@upm.es

Agradecimientos: The authors want to acknowledge the support from the European Commission through the project Erasmus+ EAC-A03-2018-KA named "IE3".



©2021 by the authors. Licensee AEIPRO, Spain. This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (<https://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

New generations currently attending university courses exhibit specific behaviour, not observed in earlier generations, as the result of being exposed to internet and social media tools from the beginning.

Currently most of research studies are focused on Millennials, but the younger, lesser-known generation now named as Generation Z grew up without much fanfare (Povah and Vaukins 2017). The oldest of this post-Millennial generation arrived to college in 2014, and more than four years later, Generation Z students fill our classrooms, and campus programs (Khan and Al-Shibami 2019). 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. Thus, generational research can provide institutions with valuable information to design effective policies, programs, and practices.

No different from generations before them, Generation Z's focus when coming to college is to learn and acquire the skills necessary for their future careers. Learning for them, however, is markedly different from that of previous generations. Findings from North-eastern University's Innovation Survey highlight that Generation Z students prefer to engage in hands-on learning opportunities in which they can immediately apply what they learn to real life, and they describe the ideal learning environment as *“need[ing] to be actively doing the learning to obtain the most information.”* University officials continue to face new challenges in meeting the needs of an increasingly diverse student body and fulfilling an expansive institutional mission (Blake 2007). To configure more efficient learning procedures is a requirement, but this behaviour can be identified as well as to professionals looking to enlarge their knowledge.

Because of the highlighted characteristics of over-stimulation, digital multichannel sources, lack of patience, it becomes even harder managing classes lasting one hour and a half and involving many slides and concepts. Providing a vibrant learning environment for Generation Z will require creative approaches that combine social interactions, technology, and assignments that simulate real-life work situations or are community outreach projects. New technology platforms may be required as well as faculty development to learn methods for teaching Gen Z that includes more than technical approaches.

The goal of the paper is to present a new competence oriented educational configuration. Micro learning combined with the Knowledge Graph representation (KG) as well as an advance competence approach enabling embed assessment of knowledge related to both nodes/concepts and arcs/relationships.

The interest of such learning structure is that enables self-guided, independent asynchronous learning of concepts as auxiliary but yet relevant elements. By giving learners the option for such learning path, when the course involves blending or synchronous activities, such organization opens a bigger space for innovation. This is because when formal lecture presentations of contents are removed, more options for training oriented approaches appears, including open discussions about relationship between concepts or case studies.

More practical application to real cases, including software tools are well suited, emphasizing the opportunities to acquire additional soft skills linked to the cooperative work and noisy environments.

2. Methodology

Based on the preliminary work carried out in (Ordieres Meré et al. 2020) the competence concept was adopted by following the current status of the art, where scholars have identified two main categories of competences, Individual and organizational competencies. Still, independently from the adopted taxonomy, it is convenient to fix the competence

understanding, which will require, a definition, a description, and a measurement criteria (see Figure 1).

Figure 1 : Competence understanding.



Indeed, in order to refine the goals, a case base analysis was adopted as methodology. To this end, aiming to present specific ways of implementing transformed IE&M courses, a Project Management module was selected. Then the KG was established, as summarized in Table 1, where the first column represents the knowledge area, in close relationship with the competences to be mastered, and then the already mentioned triplets are presented for a few cases.

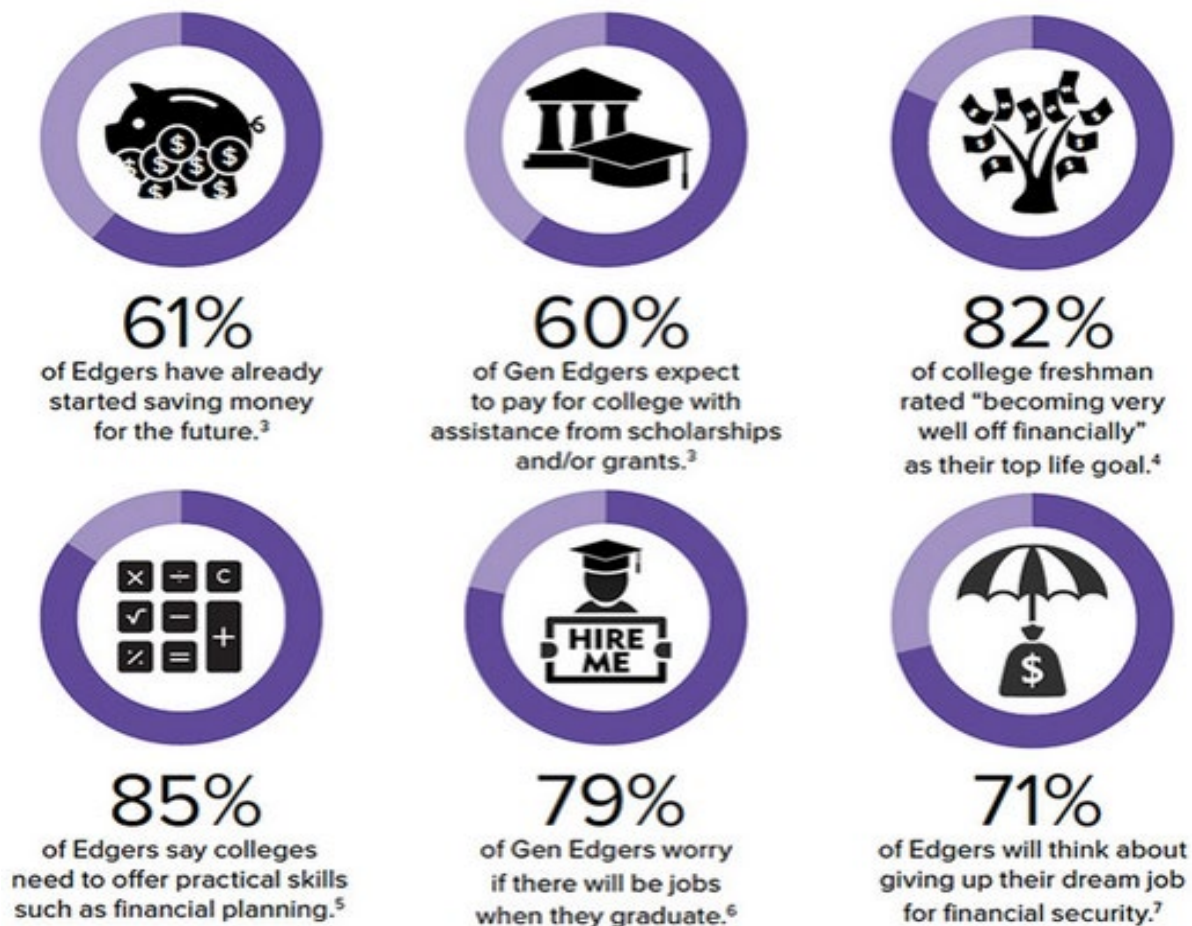
Table 1 Random Entries from the KG for the PM course

Knowledge Area	Subject	Relationship	Object
General	PM	has management capabilities in	Project Integration
General	Phase	has common	Processes
General	Project Management	is different from	Project
General	Project Management	is different from	Project Deliverables
Scope	Scope	aims to deliver	Deliverables
Scope	Scope Management	aims to deliver	Required Deliverables
Scope	Scope Management	includes	Scope Planning
Scope	Scope Management	includes	Scope Definition
Scope	Scope Management	includes	Scope Assessment
Scope	Scope Management	includes	Scope Control
Scope	Scope Definition	can build	WBS
Scope	Scope Definition	can build	PBS
Scope	Scope Definition	is critical for	Project Success
Scope	Scope Management	considers	Alternatives
Scope	Scope Management	requires	Stakeholder Analysis
Planning	Project Plan	can include	Scope Planning
Planning	Project Plan	can have	Few Scope Planning Levels
Planning	Prince2	uses	PFD
Planning	Prince2	uses	PDD
Planning	Task Duration	requires	Forecasting Method
General	Methodology	does not require	Specif. Forecasting Method
Planning	GANTT	is a	Scheduling Method
Planning	PERT	is a	Scheduling Method
Planning	CPM	is a	Scheduling Method
Planning	CCPM	is a	Scheduling Method
Planning	ROY	is a	Scheduling Method
Planning	PERT	is a	Network Diagram
Planning	ROY	is a	Network Diagram

As the approach is addressing Z-gen participants, which are fully digital, it is clear according to introduction that there are some constraints to consider, such as digital based media where the central element are video content, but also their lack of patience, with attention limited to 8 secs, and clear motivation for the added value for the concepts gathered in relation towards the labor market. Actually, such characteristic behavior is a key element to select a micro-learning based approach to gather fundamental concepts, which is also well connected with some other characteristics from the targeted learners, as they also exhibit social behavior but also individualism for learning patterns and experiences (Forbes 2017; Roszak, Mokwa-Tarnowska, and Kołodziejczak 2019).

Providing a hybrid design involving both, synchronous and asynchronous activities as well as individual and social behavior, if combined properly, can make the difference against more classical courses, in particular when new generations are targeted (see Figure 2), as they are also concerned with applicability of the university time and opportunities after college.

Figure 2 : Typical concerns from Generation Z.



Based on those aspects, it is worth to consider some degree of complementarity between the theoretical knowledge background (with good characteristics to be acquired on their own pace, according to their preferences and already existing knowledge) and practical skills, when applied to solve specific engagements (in this case the value comes from sharing different alternative solutions among participants able to understand each alternative as well as to

discuss values and limitations).

3. Implementation Details

Preparing learning experiences to emphasize shared learning, to be developed at least partially at classrooms strongly depend 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 Scope Plan
- Project Schedule Plan
- Project Cost Plan
- Risk management plan.
- Assessment of the project development
- Crisis management, when different issues happen.

However, far away of the practical assessment of the exhibited performance, including steering information at team level, this work focuses the interest in tools enabling the learning path of the required concepts, tools and relationships. Therefore, the proposal is, when addressing the first aspect, to develop micro-learning content 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.

Main reason for micro-learning is to facilitate concept acquisition for Z-gen members as the visual teaching such as tik-tok, youtube, etc., shall be one way but not the exclusive one. To organize concepts and relationships a full competence structure need to be provided. Competencies describe the level of understanding or proficiency of a learner in certain subject-related skills (Whitley 2002). On the other side, competency-based learning or skills-based learning, refers to systems of assessment and grading where learners demonstrate these competencies.

It was decided to use classical Learning Management System (LMS) as a convenient tool to implement the Competence framework, and Moodle was selected for this purpose, as indicated in Figure 2, where its different entries are grouped under the taxonomy keyword (Stefanova and Nikolova n.d.). It looks to define every framework row, by setting the language string keys used to describe competencies at each level of the framework (Then et al. 2016). In present case, the adopted taxonomy organizes the knowledge in four layers, where the concept is the atomic item and 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. Combination of skills will provide integrated perspective in a higher level, named competency. Finally, competencies are arranged by Domains of knowledge (Rezgui, Mhiri, and Ghédira 2014).

For the presented implementation Domains are 'General Knowledge/Organizational', 'Scope', 'Cost', 'Risk', 'Stakeholders', 'Assessment', 'Reporting', and 'Maturity'. For each of the domains or knowledge areas, several competences can be linked. Therefore, when Organizational Domain is considered, it was decided to highlight competency for Setting up the Project Characteristics, as well as Project agents recognition and relevant activities and roles. Finally, it was decided to include the competence to recognize different methodologies relevant for project management (see Figure 3).

Figure 3 : Implementation of the Competence Framework in Moodle LMS.

PM Competence Framework

Edit competency framework

[Collapse all](#)

▼ **General**

Name !

Description ! ?

↵ A B I

Framework of Competencies in Project Management

ID number !

Scale ! ? ⬆
[Configure scales](#)

Visible ? ⬆

Category System

▼ **Taxonomies**

Level 1 ⬆

Level 2 ⬆

Level 3 ⬆

Level 4 ⬆

By following the same approach, when a single competency is selected different skill entries become relevant. Just as an example, when Project agents is 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.


Such structure can be realized at the competence framework definition in Figure 4, where the atomic elements can be related to them as appropriate. In our case, the skill related to the Project Management understanding can rely on her responsibilities, the relevant knowledge areas s/he will be required to manage.

Figure 4 : Implementation of skill items into the Competence Framework.

PM Competence Framework

Framework of Competencies in Project Management

Competencies




- ▼ PM Competence Framework
 - ▼ Organisational
 - ▶ Project Characteristics
 - ▼ Project Agents
 - ▼ Project Manager
 - Responsibilities**
 - Knowledge Areas
 - Legal agents
 - SiteWork Responsible
 - Owner
 - Team Managers
 - Project Engineer
 - Project Management Methodologies
 - ▶ Scope
 - ▶ Scheduling
 - ▶ Cost
 - ▶ Risk
 - ▶ Stakeholders
 - ▶ Assessment
 - ▶ Reporting

Selected concept

Responsibilities 1.2.1.1 [Edit](#)

Cross-referenced competencies:

No other competencies have been cross-referenced to this competency.

 Add competency

In order to be consistent, it is possible to link either skills or concepts to competencies other than the one hierarchically related, as exhibited in Figure 4. In this way it is not needed to replicate same concepts across the different competencies.

Another interesting concept is the competency rule. They can be added to any competency in a framework, as long as it has children. A competency rule can be used to automatically mark as complete a parent competency when all children of it are complete. Linking the child competencies to course activities combined with the competency rule 'Mark as complete when all children are complete' will award the parent competency to a learner when s/he has successfully completed the course activities or when s/he gets the required proficiency level.

The next step to implement a proper micro-learning context is to generate different learning artifacts, including concept and relationship explanations as well as some exercises able to demonstrate gaining enough insights. In Figure 5 different micro-learning items are presented, some of them text based for reading, some of them video based and, to validate the gathered knowledge a quiz linked to a competence rule.

It is worth to mention that in addition to the assessment task itself, the experience can be reused to provide additional feedback to learners when the workshop activity is accomplished, because of the learner not only experience the rubric based assessment to the non-direct question, which requires to mobilize additional understanding, but she also will learn by analysing what other colleagues did, and how they faced the task. In such a way both, individual and social learning become possible, while still asynchronous assessment was undertaken.

In addition, still room remains to implement additional serious gamification techniques for synchronous experiences, when competition stimulates participation between learners. Literature show that serious games have a potential of creating learning environments to better reach the educational and training goals (Cagiltay, Ozcelik, and Ozcelik 2015). The game design characteristics and game elements are need to be explored in detail for increasing the expected benefits of the gaming environments, in particular when the synchronous dimensions are used to increase the engagement levels.

4 Conclusions

In this work a proposal to leverage the new requirements coming from Z-gen learners has been elaborated. The strong aspect to be emphasized is work inside a competence framework approach, but differentiating the personal learning from the shared learning, where both spaces are specific and complementary.

For the basic knowledge acquisition, where concepts, tools and basic relationships are involved, a micro-learning based context has been proposed, where different type of media content are available, according to the learning preferences of the audience and where some kind of asynchronous learning is encouraged. In this way implementations of flipped classroom methodologies fit perfectly with the proposed framework.

For the social learning, the focus is to address more sophisticated problems or issues where different solutions can be proposed and where discussing advantages and limitations of each of them are valuable. Indeed, where implementation of specific ideas provides benefits to the participants as they can analyze their own work as well as the work of competitors. Such aspects can be emphasized either by synchronous serious gamification tools, or because of asynchronous assessment tools.

With separation between individual asynchronous concept based learning and synchronous social oriented activities focused on increasing learning practical dimensions through team participation on case study analysis, team oriented project development, discussions, and similar activities, the course design is in accordance to the interest the new generations exhibit regarding its education pattern. Indeed, visual content for learning and micro-learning also match with their requirements for attention and gamification stimulates competitiveness as a key for increasing their engagement. The remaining aspect to be carefully considered is the vertical and horizontal integration, which requires deeply strategic design for the degree, including links to other requirements which are out of the scope of the current planning level as identified in this contribution.

Keeping the attention level at course design considering competences as common driver for learner achievements, and in order to facilitate the deployment, the competence framework and tools have been implemented into a classical LMS such as Moodle, where the competences module has been enabled.

From the formal point of view all the elements required to digitally improve the Industrial Engineering and Management concepts have been reviewed. However, it is needed to recognize that implementation details need to be collected, by running the experimental courses and identifying aspects to be improved. Such pilot testing process is foreseen for the next academic semester, in Fall 2021.

5 References

- Blake, J. Herman. (2007). "The Crucial Role of Student Affairs Professionals in the Learning Process." *New Directions for Student Services* (117):65–72.
- Cagiltay, Nergiz Ercil, Erol Ozcelik, and Nese Sahin Ozcelik. (2015). "The Effect of Competition on Learning in Games." *Computers & Education* 87:35–41.
- Forbes. (2017). "Council Post: How To Win The Hearts Of The Gen Z Consumer Base In Eight Seconds."
- Khan, Iftikhar Ahmed and Ahmed Hamoud Al-Shibami. (2019). "Generation Z's Learning Preferences: Impact on Organisational Learning and Development-a Study Conducted in a Vocational Institute in UAE." *International Journal of Learning and Change* 11(4):379–99.
- Ordieres Meré, Joaquín, Miguel Ortega Mier, Gustavo Morales Alonso, and Mercedes Grijalvo Martin. (2020). "Retos Que La Digitalización Induce En La Educación Europea Sobre Gestión Industrial."
- Povah, C. and S. Vaukins. (2017). "Generation Z Is Starting University--but Is Higher Education Ready." *The Guardian* 10.
- Rezgui, Kalthoum, Hédia Mhiri, and Khaled Ghédira. (2014). "Extending Moodle Functionalities with Ontology-Based Competency Management." *Procedia Computer Science* 35:570–79.
- Roszak, Magdalena, Iwona Mokwa-Tarnowska, and Barbara Kołodziejczak.(2019). "E-Learning Competencies for University and College Staff." Pp. 185–200 in *Universities in the Networked Society*. Springer.
- Stefanova, Eliza and Nikolina Nikolova. (2018) "Designing a Competence-Based Learning Course with Digital Tools in Higher Education." *Trends and Applications in Information Systems and Technologies: Volume 3* 202.
- Then, Matthias, Benjamin Wallenborn, Michael Fuchs, and Matthias Hemmje. (2016). "Towards a Domain Model for Integrating Competence Frameworks into Learning Platforms." *Formamente-International Research Journal on Digital Future* (3):4.
- Whitley, Richard. (2002). "Developing Innovative Competences: The Role of Institutional Frameworks." *Industrial and Corporate Change* 11(3):497–528.

**Communication aligned with the
Sustainable Development
Objectives**

