World Journal on Educational Technology: Current Issues

Volume 09, Issue 2, (2017) 67-74

www.wj-et.eu

Idm@ti Network: An innovative proposal for improving teaching and learning in Spanish universities

Nuria Salan*, Department of Materials Science and Metallurgical Engineering, Universitat Politècnica de Catalunya (UPC), 08034, Barcelona, Spain.

Luis Cabedo, Department of Industrial Systems Engineering and Design, Universitat Jaume I (UJI), 12080, Castello, Spain.

Mercedes Segarra, Department of Materials Science and Metallurgical Engineering, Universitat de Barcelona (UB), 08028, Barcelona, Spain.

Teresa Guraya, Department of Mining and Metallurgical Engineering and Materials Science, Universidad del País Vasco (UPV-EHU), 48940, Leioa, Spain.

Pascal Lopez, Department of Civil Engineering of Materials and Processing, Universidad de Málaga (UMA), 29071 Málaga, Spain.

David Sales, Department of Materials Science, Metallurgical Engineering and Inorganic Chemistry, Universidad de Cádiz (UCA), 11001, Cadiz, Spain.

Jose Gamez, Computing Systems Department, Intelligent Systems and Data Mining Laboratory, Universidad de Castilla-La Mancha, 02071, Albacete, Spain.

Suggested Citation:

Salan, N. Cabedo, L. Segarra, M., Guraya, T., Lopez, P., Sales, D. & Gamez, J. (2017). Idm@ti Network: An innovative proposal for improving teaching and learning in Spanish universities. *World Journal on Educational Technology: Current Issues. 9*(2), 67-74.

Received from; 01 March 2017 revised from; 21 March 2017 accepted from; 03 April 2017

Selection and peer review under responsibility of Assist. Prof. Dr. Fezile Ozdamli, Near East University.

Abstract

IdM@ti network members concurred in the diagnosis of the difficulties and opportunities arising from Bologna process implementation and teaching methodologies improvement in Materials Science and Engineering (MSE) teaching. This network has been created with the aim of improving efficiency of underway and future collaborations.The main objectives are related to MSE resources sharing (course programs, exercises, lab scripts, projects, PBL and case studies, etc.). The network will allow classifying those educational resources already individually implemented by each University, monitoring their statewide and promote the creation of new resources. In order to promote discussion and sharing of experiences, achievements and challenges, a workshop is annually organized, arose from the convenience of joining forces on the axes of innovation and improving the quality of teaching in MSE field.

Keywords: materials science and engineering, teaching innovation, community of practice, pbl.

*ADDRESS FOR CORRESPONDENCE: **Nuria Salan,** Department of Materials Science and Metallurgical Engineering, Universitat Politècnica de Catalunya (UPC), Spain. *E-mail address:* nuria.salan@upc.edu, Tel.: +34-937-398-142; fax: +34-937-398-126.

1. Introduction

Innovation in teaching, like all work in research, is based on studies, analysis, design and testing experiences (trial and error) of the effectiveness of the proposed methodologies. In the field of Science and Technology of Materials, IdM@ti is born as a network of faculty and research staff to share experiences and to promote quality teaching at Universities. IdM@ti (Inter-University Network for Materials Science and Engineering Innovation Teaching), was established in 2011, by following the 3th International Materials Education Symposium, organized by Granta Design[*] and the University of Cambridge, in which teachers share experiences and present the innovations on applications of software CES-Edupack. The main aim of IdM@ti is related to be a platform for information and experience exchange between members of the member universities concurred in the diagnosis of the difficulties and opportunities arising from the implementation of the Bologna process and the new teaching methodologies (Castells, 1996, Pozo 2006), so that this network was created with the aim of improving the efficiency of collaborations that were already underway. It currently includes seven Spanish universities, but open to all other universities, with the initial support of Granta Design (Fig.1).

Figure 1. IdM@ti foundation member universities

The network aims to share resources for the teaching of subjects related to Materials Science and Engineering such as course programs, exercises, lab scripts, projects and case studies in order to improve the quality of teaching (Fig. 2). A 2.0 website to support all shared materials is being developed, were all the resources will be available for teachers and students. This will allow classifying those educational resources already individually implemented by each University, monitoring their state wide and promote the creation of new resources. A Spanish workshop is annually organized for discussion and sharing of experiences, achievements, challenges, etc., that arise from the implementation of the new degrees. According to the conventional definition, knowledge is a true and justified belief and a large portion of our knowledge is based on experience. According to this definition, new learning techniques have been introduced with the Bologna process. Applying tools from a recent global initiative led by OECD (Assessment of Higher Education Learning Outcomes, AHELO,) different Basic Materials Science courses will be compared by using new learning methodologies.

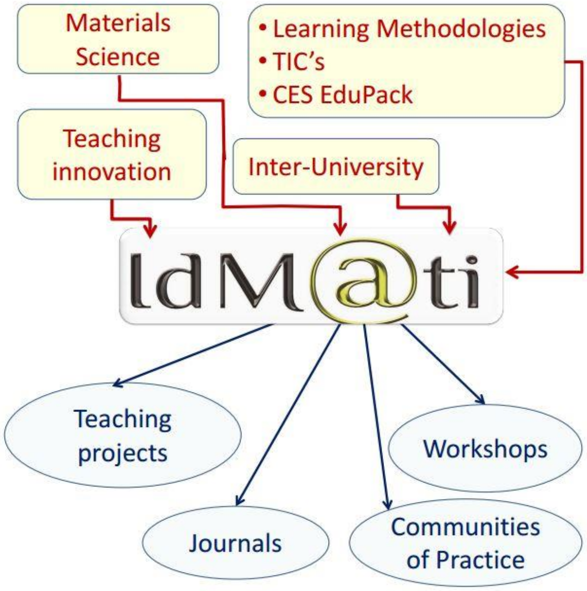

Figure 2. IdM@ti structure

2. PBL IdM@ti activities

Once described the current educational context we believe that a good tool to address this issue is the Project Based Learning (PBL). The PBL is a model of learning in which students raise, implement and evaluate projects that have an application in the real world. This method uses problems as a starting point for the acquisition and integration of new knowledge (Barrows, 1986). By knowing this, one of the first joint actions between members of the IdM@ti network is the implementation of a new experience in different Universities (Fig. 3).

	Degree in Engineering	Mat. Sci. level	Group size	Nº subgroups
EHU	Mecha-Electric-Electronic	Fisrt	60	12
UJI	Industrial Design	Fisrt		
UCA	Industrial Technology	Second		

Figure 3. IdM@ti PBL activity in which 3 universities are involved, showing students background

Thus, several project based learning activities have been developed since IdM@ti foundation. In these activities, carried out simultaneously at three universities linked to network IdM@ti, students reached from different backgrounds. As an example, in Fig. 3 is shown members of a PBL project in which are involved EHU (Universidad del País Vasco), UJI (Universitat Jaume I de Castelló) and UCA (Universidad de Cadiz). In other experience, undergraduate students studying Materials Science course in Mechanical, Electrical, Electronic and Design Engineering degrees from four different universities (UJI-Castelló, UB-Barcelona, UMA-Málaga and UPV-EHU-País Vasco) were encouraged to design a new generation of razor blade product. Individual and team videos as well as technical reports were evaluated as part of the final mark that includes PBL and regular test qualifications. The correlation between PBL and test results for each student was also analyzed. In this experience, students were provided with three grades of commercial razor blades from the most relevant brands. Each group had to select three models between them to work on. Materials and processes involved on manufacturing had to be exhaustively analyzed. A prospective investigation on customer identified improvements was required in order to define their project goal: a new product with distinguishable characteristics/usefulness. A workspace for each group was provided on Moodle platform. Some of the students also used private google.site, google.docs like tools. CES EduPack was supplied to all students and communication between groups from different universities was suggested. Most of the work was non-presential. Three presential sessions were programmed to show and discuss the progress of the project.

Students were assessed in both skills and knowledge specific for materials science and competences, skills and capacities for an engineer (Fig. 4) by means of the following tasks:

- personal video describing differences in packaging, price, number of materials and constructive solutions used in the three blades selected
- personal video discussing materials and processes used in relation with performance and manufacturability and how materials have been identified
- group video presenting their own design in free format
- final report describing their own design including materials selection, product characteristics and improvements, LCA and a basic cost analysis and their customer goal
- reports form the group meetings
- frequency and objective in TICs use
- Information exchange between industrial design and other engineering students

	Videos	Reports	Actas	TICs
To know materials families, their properties and main differences	✓	✓		
To know relationships between materials composition, manufacturing processes and performance	✓	✓		
Materials properties, characterization, units and magnitude		✓		
Collaborative work in groups	✓	✓	✓	
Project management	✓	✓	✓	✓
Responsability with collegues			✓	✓
Coninuous learning		✓		✓

Figure 4. Relationship between skills and knowledge specifics for materials science and assessment activities.

As other methodologies, PBL requires a series of well-structured and planned steps set by the teacher. Moust, Bouhuijs and Schmidt (2007) and Schmidt (1983) proposed seven steps to implement the resolution of the project, which point the many cognitive processes and competencies required to the students (Fig. 3), in order to develop skills such as problem solving, decision making, teamwork and communication (Michael, 2005):

1. Clarification of concepts and terms that appear in the proposal project from the dialogue between group members.
2. First tentative definition of the problem. After steps 3 and 4 this step can be repeated if considered necessary.
3. Analysis of the problem from the contributions of all group members through brainstorming.
4. Development of a systematic summary with several explanations to the analysis of the previous step. Once generated the greatest number of ideas about the problem, the group tries to systematize and organize them, highlighting the possible associations among them.
5. Set up of learning objectives and common decision on aspects of the problem, which are to be investigated and understood.
6. Search for more information, individually.
7. Synthesis of collected information and writing a report on the acquired knowledge.

Thus, knowledge is gained while they learn to learn in a progressively independent way as well as they learn to apply that knowledge in solving various problems similar to those they face in the performance of different facets of this work: working in teams under supervision, being progressively autonomous, identifying learning goals, managing time effectively, identifying which aspects of the problem can be ignored or need to explore more deeply and investigating on their own, thus directing their own learning. Through this process, they benefit from the participating peers, which provide the necessary contrast to their inquiries and ways of understanding what they are studying (Vizcarro & Juárez, 2009).

Despite the predictable difficulty that would involve the implementation of this methodology in material science subjects in engineering degrees, the potential benefits for the students motivated us to start this educational experience, addressed to study the feasibility of using PBL methodology in those subjects in different degrees of Spanish public universities.

3. PBL development and results.

Acceptance of the project and the involvement of students had different nuances in each university, and the average number of hours dedicated to the project exceeded 15% the plan. It was also noticed a certain degree of competitiveness that we believe may be beneficial since it reflects a personal involvement with the project and desire to excel. A direct correlation between the number of students involved in the PBL activity and the level of involvement and student motivation is observed then. We observed how a great number of students who developed PBL activity increased their interest in the subject. Possibly this behavior comes motivated by greater attention to the student by the teacher. A similar trend between the percentage of PBL activity on the final grade for the course and the level of involvement and student motivation is observed.

The project has eased to find objective ways to evaluate transversal competences as well as its evolution over the semester in the four universities. This process involves a change in evaluation methodology, hard to implement in the field of engineering (Fig. 5). It has been observed that the level reached in the competences of specific knowledge of the subject during the PBL activity had direct positive relationship in the outcome of the evaluation of the same competences by traditional methods (development of a written answer to a question).

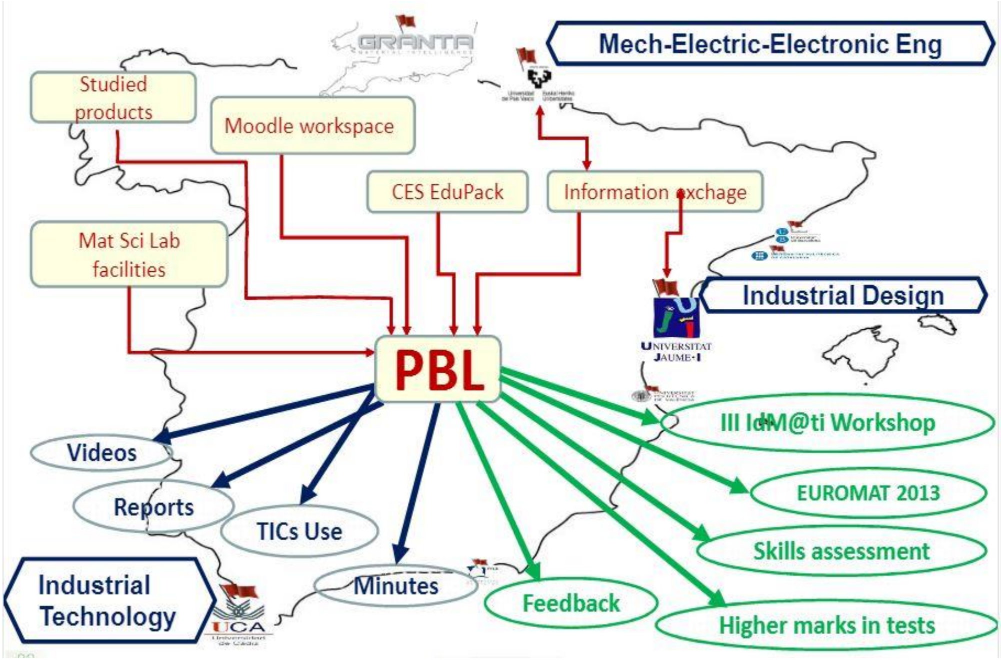

Figure 5. PBL activities structure from a particular project which involves several Spanish universities members of IdM@ti.

Therefore it is found that the specific knowledge gained through independent learning is solid and remains after the activity is finished. In the discussion meetings that were held with students after the experience, the following perceptions were recorded: the students were very receptive and said it was an experience that allowed them to find their way. They noted that, initially, the transfer of responsibilities from the teacher to the students disturbed them, but as they proceeded with the project they developed more autonomous and more independent learning strategies. They agreed that, through the PBL, learning stayed longer.

Unlike rote learning, this system provided them with greater retention over time. Despite the difficulties encountered with some members of their group, all participants recommend this method of learning to the rest of his classmates. The teachers, on their side, were satisfied with the experience, given the good results obtained; however, the project required an immense amount of work from the teachers and it was concluded that its organization should optimize instrument/evaluation criteria to make the evaluation more objective and less time consuming. A very good acceptance between students and feedback has been detected. Additional skills are trained (in product design process) but these experiences result a hard work for teachers. Materials Science and Technology contents have been interiorized by students as well the higher marks in PBL activity the higher marks in conventional tests.

4. Conclusions

According to the conventional definition, knowledge is a true and justified belief and a large portion of our knowledge is based on experience. In this context, PBL techniques have been applied within the Bologna process with good results.

As a conclusion obtained from these works, the project-based learning arouses interest in the students and helps them to understand their own knowledge of the subject and therefore more successful working with specific skills. Also, this type of approach facilitates working transversal skills and creating and implementing activities and evaluation criteria for these competencies. Specifically, the PBL activity has improved skills in the students such as writing technical documents, search for information, teamwork and presentation of results.

As the assessment was continuous, we observed great progresses in the different tests. For example, the quality of their exposition increased during the process. Therefore, this experience has been very positive for teachers but also for students.

Some proposals for the future that we think that must be considered are:

- Involve the students in evaluating their peers
- Develop tools to carry out team work effectively and thus reduce the workload of students and teachers
- Improve the efficiency of the evaluation instruments
- Use evidence assessment activity (surveys) for internal use by teachers

Finally, feasibility of implementing PBL methodology has been demonstrated by means of similar projects for different degrees and curricula, which open prospects for collaboration. This is the line of work that is intended to continue within the network of educational innovation IdM@ti

References

Antepohl, W., Herzig, S. (1997) *Problem-based learning supplementing the course of basic phamacology - results and perspectives from two medical schools*. *NaunynSchmiedeberg's Archives of Pharmacology*, 355, R18.

Barrows, H.S. (1986). *A Taxonomy of problem-based learning methods*. *Medical Education*, 20(6), 481–486.

Castells, M. (1996). *La era de la información. Economía, sociedad y cultura*. Vol. 1 México: Siglo XXI. *1st International Conference on Higher Education Advances*, HEAd´15 This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND 4.0). 286

Delors, J. (Coord) (1996). *La educación encierra un tesoro*. *Informe UNESCO de la Comisión Internacional sobre la educación para el siglo XXI*. Madrid, Santillana.

De Miguel, M. (coord.). (2005). *Metodologías de enseñanza para el desarrollo de competencias*. *Orientaciones para el profesorado universitario ante el Espacio Europeo de Educación Superior*. Madrid: Alianza.

Jonassen, D. H., S., & Khanna, K (2011), *Implementing problem based learning in materials science*, Proceedings of the 2011 ASEE Annual Conference and Exposition, Vancouver, 2011.

Moust, J.H.C., Bouhuijs, P.A.J., & Schmidt, H.G. (2007). *El aprendizaje basado en proyectos*: *Guía del estudiante*. Cuenca: Ediciones de la UCLM.

Orozco, J., Guraya, T., Ibarretxe, J., Cabedo, L., Gómez, J., Izquierdo, R., Sales, D., González, D., Lopez-Crespo, P., Segarra, M., Salan, N., & Olivella, G. (2012) *Interuniversity network for Innovation in Materials Science Teaching*, *Proceedings of 4th International Materials Education Symposium*.

Pawson, E., Fournier, E., Haight, M., Muniz, O., Trafford, J., & Vajoczki, S. (2006). *Problem-based learning in geography: Towards a critical assessment of its purposes, benefits and risks*. *Journal of Geography in Higher Education* 30 (1), 103–116.

Pozo, J.I. (2006). *La nueva cultura del aprendizaje en la sociedad del conocimiento*. *Nuevas formas de pensar la enseñanza y el aprendizaje. Barcelona:* Graó (ISBN 84-7827-432-4).

Reeves, T Y Laffey, J. (1999). *Design, assessment, and evaluation of a problem-based learning environment in undergraduate engineering*.*Higher Education Research and Development*, *18*(2), 219-232.

Schmidt, H.G. (1983). *Problem-based learning: rationale and description*. *Medical Education*, 17, 11-16.

Vizcarro, C. Y & Juárez, E. (2009). *Qué es y cómo funciona el aprendizaje basado en proyectos? La metodología del Aprendizaje Basado en proyectos*. Consultado en fecha 20/01/2015. http://www.ub.edu/dikasteia/LIBRO_MURCIA.pdf