

# M-learning + ARD for problem-based learning: a work-life readiness strategy

Virtual laboratory for business practices

Sandra L. Torres Taborda  
Universidad de Salamanca.  
Salamanca, España  
storresta@usal.es

Sonia Casillas-Martín  
Universidad de Salamanca.  
Salamanca, España  
scasillasma@usal.es

Marcos Cabezas González  
Universidad de Salamanca.  
Salamanca, España  
mcabezasgo@usal.es

## ABSTRACT

This dissertation explores how m-learning or the use of mobile devices as a support tool in the teaching-learning process is part of the educational innovation that suggests the influence of Information and Communication Technologies (ICT), in the pedagogical orientation directed to the university population. The paper exposes how problem-based learning (PBL) is a facilitator for the application of action research and decision making, and how the creation of a virtual laboratory for the realization of business practices that works through a mobile application will favor the symbiotic relationship University - Company by enabling the approach of students with the productive sector; bringing them closer to the business environment, challenging them to generate alternative solutions to real problems and preparing them for their intervention in society as future professionals. The goal is that by incorporating mobile digital elements easily accessible to students (smart phones, digital tablets and technologies related to the Internet) in teaching strategies, collaborative learning and knowledge generation will be motivated. The program is intended for students of the Faculty of Business and Administrative Sciences of the Corporación Universitaria de Sabaneta who are currently in eighth and ninth semester and who are about to apply to the business practice phase as a requirement to qualify for the degree. For this purpose, a descriptive qualitative approach study is proposed in which different tools of information collection are linked using quantitative and qualitative methods under a pre-experimental design of a single case. Once the study has been carried out, its characteristics, responsibilities and practices will make it possible to generate a model that favors its employability in different educational contexts and training areas.

## CCS CONCEPTS

• **Information systems** → Information systems applications; Multimedia information systems; Multimedia databases; • **Human-centered computing** → Human computer interaction (HCI); Interaction paradigms; Collaborative interaction; Ubiquitous and mobile computing; Ubiquitous and mobile devices; Mobile devices; •

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from [permissions@acm.org](mailto:permissions@acm.org).

TEEM'21, October 26–29, 2021, Barcelona, Spain

© 2021 Association for Computing Machinery.

ACM ISBN 978-1-4503-9066-8/21/10...\$15.00

<https://doi.org/10.1145/3486011.3486552>

**Social and professional topics** → Professional topics; Management of computing and information systems; Project and people management; Project management techniques.

## KEYWORDS

Digitization, inclusive education, educational innovations

### ACM Reference Format:

Sandra L. Torres Taborda, Sonia Casillas-Martín, and Marcos Cabezas González. 2021. M-learning + ARD for problem-based learning: a work-life readiness strategy: Virtual laboratory for business practices. In *Ninth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'21) (TEEM'21)*, October 26–29, 2021, Barcelona, Spain. ACM, New York, NY, USA, 4 pages. <https://doi.org/10.1145/3486011.3486552>

## 1 MOTIVATION THAT DRIVES THE DISSERTATION RESEARCH

Considering that university academic training presupposes the acquisition of knowledge and the development of competencies to face autonomously and reliably the challenges of the work environment, it is necessary that the educational processes provide spaces for permanent interaction between the company and the academy. Implementing collaborative work, particularly for the development of business internships, requires careful planning of resources and the environment, to guarantee a truly cooperative structure, in addition to the accompaniment of students, the verification of the learning results contemplated in the curriculum and the adequate attention to the company that requests the intervention of the interns.

Most of the students value that they acquire more technical competencies through knowledge based on real problems and that it also enables them to discover others by themselves when using the PBL methodology, which does not occur with the traditional or expository system 1, this is the reason why this didactic technique is privileged in the formulation of the proposal. Likewise, it is considered that action research and decision making (ARD) promoted by the Humboldt University of Berlin is an excellent alternative for the academy to strengthen its relationship with the productive sector, because this research methodology has direct influences of the consultancy 2 and is executed under the model of commissioned or contracted studies; seeking the practical usefulness of their results for the entities that request them 3.

In addition to the above, the relationship with the external sector (community and productive sector) becomes one of the principles that guides the substantive function of Higher Education Institutions in Colombia 4 and is one of the aspects to be evidenced before

the Ministry of National Education at the time of requesting permits for the offering of programs; highlighting the importance of facilitating the transfer of knowledge through academic practice and establishing a privileged and reciprocal interaction between the knowledge obtained at the university and the needs of the business context of the region where the institution has influence.

On the other hand, the technological appropriation and massive use of digital devices can favorably articulate the university-industry relationship and be enriched by the recreational and motivational component of m-learning 5. With the support by today's mobile technologies to e-learning within d-learning (distance learning) concept, the notion of m-learning provided technological progress in education. The most important advantage of m-learning to e-learning is accession by the student to demanded information independent of time and environment 6. This situation could be very favorable in the Latin American context, as the use of mobile technologies could become an important part of the solution to close the educational gaps 7 and inclusive education can be developed in face to face and virtual educational environments 8. For example, Tablets are considered nowadays between the main mobile technological devices that can foster different dimensions of learning linked to digital competence. Therefore, a growing number of schools are integrating Tablets in their teaching methods in diverse countries 9. For this reason, a mobile application is projected to bring together companies with current needs and students in training who need to approach the challenges of professional practice.

A business internship program that takes into consideration the generational characteristics of students, the digital demands of society and the specification of problematic situations within companies with the conditions of limited resources and quality requirements in the results experienced in the productive sector, helps to facilitate the transition from the role of university student to that of professional, while stimulating the accumulation of experience, skills development, field application of acquired knowledge and the incorporation of soft skills before facing the labor market. Becoming a proposal that fits the importance that universities should give to technology and its implications, since the notion that we move in a digital society should be a priority for the learning of their students 10, without forgetting that technology adoption models are an effective alternative for studying the acceptance of these technologies by teachers 11.

This paper presents advances in the theoretical basis of the research. The context refers to the background, objective, justification, and delimitation of the study. Section 3 explains why m-learning, PBL and ARD are the basis of the thesis proposal. Subsequently, the hypothesis of the work and the way the research methodology is carried out are presented, as well as the expected results and contributions.

## 2 CONTEXT THAT DRIVES THE DISSERTATION RESEARCH

The virtual laboratory for business practices will be implemented at the Corporación Universitaria de Sabaneta, a Higher Education Institution with 12 years of existence and located in the smallest municipality in the country -which bears its name-, but which has

approximately 870 companies registered with the *Cámara de Comercio* 12. This means that the field of action from the academy is quite broad in terms of action and intervention within the productive sector. Without considering that the institution exerts influence in the sub-region Valle de Aburrá, in which the city of Medellín and its metropolitan area are located; with a contribution in the Gross Domestic Product (GDP) of 68% of the total of the Department of Antioquia 13.

The intervention will be carried out with all the students of the School of Business and Entrepreneurial Sciences who are in the stage of business practice as a requirement to qualify for the degree, that is, enrolled in the subject Degree Option; for an approximate total of between 60 and 100 students and a group of micro, small and medium-sized companies registered with the Chamber of Commerce of Aburrá Sur; which will participate as practice agencies for the students.

In relation to the virtual laboratory of business practices, we are working on the creation of a mobile application for the management of the same because nowadays, m-learning is developing more and more hand in hand with the growing app industry 14; the main objective is to promote constant communication among the actors and, above all, to encourage the students' attention and enjoyment of the work performed by interacting with entrepreneurs through their cell phones, an instrument with which they are very familiar.

Having the possibility of being in contact with the company and fulfilling the academic responsibilities of the practice through a mobile application is significant, since it adjusts to the natural daily behaviors of millennials and centennials, allows multichannel and multimedia interaction between the actors of the process and in turn, instructs in the development of digital skills that sometimes are taken for granted in students and that in several opportunities it has been evidenced that they do not possess, since age is not a conditional of achieved skills or even considered as "innate"; At least in Latin America, there are other factors that determine the usability and appropriation of ICTs: socioeconomic and demographic context of the individual.

In Colombia 15 it is evident that in the third quarter of 2020, the total number of mobile lines was 65.478.177; equivalent to a penetration of 129,99% and a study on mobile consumption in the country revealed that Colombians use their cell phones 2.000 times a day in the exercise of different activities (accessing social networks, taking pictures, games), while it was shown that the smartphone continues to reign as the preferred device of consumers for most of the actions they do online, becoming indispensable in everyday life 16.

The Core ICT Households Indicators Technical Bulletin 17 based on the last National Census conducted in the country, reflects that the proportion of people aged 5 and over who owned a smart cell phone was 78.8%; being the cell phone the most used device to connect to the Internet with 84.9%. These data are important for the purpose of this doctoral thesis proposal because of their impact on the characterization of the students and the very purpose of developing the mobile application.

The above figures reflect the rapid development of ICTs and the way they have permeated different areas of daily life. Education cannot be oblivious to this and evidently the current trend towards societies with greater access to knowledge implies new challenges

and opportunities in the design of educational materials and information delivery alternatives. In Education for global citizenship 18, the use of information technologies and the media is highlighted as one of the essential requirements for academic training and for the social participation of individuals.

### 3 THE PRACTICE LABORATORY, A PROPOSAL FOR M-LEARNING BASED ON PBL + ARD

For the pedagogical formulation of the virtual laboratory of business practices, it is identified that the PBL can favorably lead to the University - Company relationship because it helps to form university graduates 19, with profiles that respond to an active, interdisciplinary and flexible demand in the labor market, and to learn with depth and autonomy to develop, and also helps them to assume the importance of continuous training as an essential tool for their own professional development. In this sense, PBL is presented as an excellent didactic technique because its objective is that the learning process takes place in action, that is to say, the student learns by doing, acquiring an adequate methodology to face the problems that will arise in his professional practice 20. It is precisely at this point where the ARD plays a fundamental complementary role, because in its operational form it is executed based on the request of external agents seeking the fulfillment of specific requirements in order to receive recommendations for solutions to identified difficulties.

Based on this, m-learning is presented as an alternative for a mobile application to be the vehicle to facilitate and manage the practice laboratory; recognizing that the stage of business practices is ideal because it requires the use of knowledge and skills acquired in the training phase and enabling the use of PBL as a teaching technique to reach the application of research for action and decision making; delivering alternative solutions to the needs of the productive sector as a result of the intervention carried out from the academy; so that the student can apply the theoretical concepts learned in the classroom and confront them with the reality that is experienced in the organizations. In this way, the school is taken to the organizations, given the need to enhance the potential of human resources through academic and practical training, which is essential for the achievement of highly qualified professionals 21.

Technology, considered the central element in the Information Society, becomes a support for learning. Information systems are no longer elements that guide development, but tools guided by the needs of knowledge management and learning processes. From this perspective, the role of the teacher should be highlighted as a mediator of the learning process, creating learning scenarios that put the student in a critical situation; where he/she has a leading role to reflect and analyze how he/she learns, how he/she solves problems and how he/she satisfies his/her needs through his/her experiences. For this reason, the virtual laboratory of practices is promoted, so that using technology collaborative work can be facilitated, a fundamental aspect when it comes to improving competitiveness, as well as the optimization of resources, since the Internet has long ceased to be a site where information is consulted or messages are exchanged, to become an open space in which we can all be participants 22.

In terms of technology as a driver of innovation in education, "mobile learning" known as m-learning can be understood as a combination of e-learning (virtual learning) combined with mobile technology to provide meaningful learning experiences. 23 It is reported that mobile devices are used in education as mediators because they can be used to consult diverse materials and interact among the educational community, and this would imply that their use should promote the development of skills involved in the learning task. It is estimated that the active use of mobile devices can increase students' motivation in the classroom 24.

The implementation of m-learning in business practices challenges the study of how educational applications should be designed to promote the development of the skills involved in the task to be learned, and to have an effect on learning equal to or greater than the results obtained by traditional methods in the classroom, seeking an educational innovation that can be understood as a series of interventions, decisions and processes, with a certain degree of intentionality and systematization that seek to modify attitudes, ideas, cultures, contents, models and pedagogical practices 25.

### 4 WORK HYPOTHESIS

The didactic strategy of PBL, implemented through the m-learning + ARD model, can positively impact the business practice process and favor the University - Company relationship, as well as the acquisition of competencies for the university student's work performance.

### 5 RESEARCH APPROACH & METHODS

The methodology to be followed is descriptive 26 because in the formulation and validation of the m-learning + ARD model for Problem-Based Learning it is necessary to characterize the situation under study and list in detail the most representative aspects of the interventions carried out through the virtual business laboratory; so that it is possible to outline the most relevant and recognizable properties that serve to guide the desired teaching process from the pedagogical and formative point of view. For this purpose, techniques will be used from a mixed vision; quantitative and qualitative techniques that favor the description, explanation, and validation of the results.

From research process' point of view, the hypothetical-deductive method is applied, which seeks to accept or reject the hypotheses formulated 27, deducing from them conclusions that must be confronted with the facts. The design is pre-experimental of single case since the intervention is emphasized in a unit of study that, in this case, are the students of the Faculty of Business and Entrepreneurial Sciences of Unisabaneta in compliance with their entrepreneurial practice.

### 6 RESULTS

Currently, the project is in the design and application phase. For this reason, we cannot establish results. Although, to obtain the results, both qualitative and quantitative analyzes will be carried out, that will allow evaluating the dependent variables of the study: the acquisition of professional skills and competencies of students in business practice stage from m-learning + ARD model for Problem

Based Learning designed for the virtual laboratory of business practice.

## 7 CURRENT AND EXPECTATED CONTRIBUTIONS

The establishment of this m-learning model requires a careful planning, communication, and training process since it involves the interests of the students and entrepreneurs who participate in the proposal; but also of the educational institution, which not only makes possible the performance within its academic programs but also trusts the results of the project to support its regulatory commitments in reference to the requirements of the Law in order to offer the provided service. This research will help individuals to enhance their professional performance, will provide the opportunity to consolidate relationship ties between the University and the productive sector of its area of influence and will open the doors to the opportunity to create communities of practice in a broader spectrum thanks to its online condition.

## ACKNOWLEDGMENTS

This research work is being carried out within the University of Salamanca PhD Programme on Education in the Knowledge Society scope (<http://knowledgesociety.usal.es>) [28, 29].

## REFERENCES

- [1] Rosario Gil-Galván. 2018. El uso del Aprendizaje Basado en Problemas en la enseñanza universitaria: Análisis de las competencias adquiridas y su impacto. *Revista mexicana de investigación educativa*, 23(76), 73–93. [http://www.scielo.org.mx/scielo.php?script=sci\\_arttext&pid=S1405-66662018000100073](http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1405-66662018000100073)
- [2] Karin Fiege, Gesa Grundmann, and Victoriua Salazar. 2017. *Manual de Investigación para la Acción y la toma de Decisiones*. IAD. Centro para el Desarrollo Rural de la Universidad Humboldt de Berlín.
- [3] Daniel Cano, and Alejandra Molina Osorio. 2015. Estrategias Socioproductivas para la Reparación de Población Víctima del Conflicto Armado en el Oriente de Caldas. *Revista De Economía & Administración*, 12(2). <https://revistas.uao.edu.co/ojs/index.php/REYA/article/view/98>
- [4] Decreto 1330 de 2019. Por el cual se sustituye el Capítulo 2 y se suprime el Capítulo 7 del Título 3 de la Parte 5 del Libro 2 del Decreto 1075 de 2015 - Único Reglamentario del Sector Educación. 25 de julio de 2019. D.O. No. 51025. [https://www.mineducacion.gov.co/1759/w3-article-387348.html?\\_noredirect=1](https://www.mineducacion.gov.co/1759/w3-article-387348.html?_noredirect=1)
- [5] Javier Fombona, Ángeles Pascual-Sevillana, and MariCarmen Gonzalez-Videgaray. 2017. M-learning and augmented reality: A review of the scientific literature on the WoS repository. [M-learning y realidad aumentada: revision de literatura científica en el repositorio WoS]. *Comunicar*, 52, 63–72. <https://doi.org/10.3916/C52-2017-06>
- [6] Agah Tuğrul Koruc, and Ayse Alkan. 2011. Differences between m-learning (mobile learning) and e-learning, basic terminology and usage of m-learning in education. *Procedia-Social and Behavioral Sciences*, 15, 1925–1930.
- [7] Andrés Chiappe, and Roque Romero. 2018. Condiciones para la implementación del M-learning en educación secundaria: Un estudio de caso colombiano. *Revista mexicana de investigación educativa*, 23(77), 459–481. [http://www.scielo.org.mx/scielo.php?script=sci\\_arttext&pid=S1405-66662018000200459](http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1405-66662018000200459)
- [8] Emilio Crisol-Moya, Liliana Herrera-Nieves, and Rosana Montes-Soldado. 2020. Educación virtual para todos: una revisión sistemática. *La educación en la sociedad del conocimiento* 21. DOI:10.14201/eks.20327.
- [9] Juan L. Fuentes, Jesús. E. Albertos and Fermín Torrono. 2019. Hacia el Mobile Learning en la escuela: Análisis de los Factores Críticos en el Uso de las Tabletas en los Colegios Españoles. *La educación en la sociedad del conocimiento* 20. DOI:10.14201/eks2019\_20\_a3.
- [10] Juan Carlos Maldonado, Ana Beltrán Flandoli, Carlos Ortíz León, and Andrea Velásquez Benavides. 2021. Laboratorios universitarios: Experimentación e innovación. *Caso MediaLab UTPL*. *Revista Latina*, 74, 1335-1343. <https://doi.org/10.4185/RLCS-2019-1387>
- [11] José. C. Sánchez-Prieto, Susana Olmos-Migueláñez, and Francisco J. García-Peñalvo. 2017. MLearning y profesores en formación: Una evaluación de la intención conductual mediante un modelo TAM ampliado. *Computers in Human Behavior* 72, 644-654. DOI:10.1016/j.chb.2016.09.061.
- [12] Informa Colombia. (n.d.). Directorio de Empresas. Listado de empresas en SABANETA. Recuperado el 14 de marzo de 2021. [https://www.informacolombia.com/directorio-empresas/localidad\\_sabaneta](https://www.informacolombia.com/directorio-empresas/localidad_sabaneta)
- [13] Departamento Administrativo Nacional de Estadística [DANE]. 2018. Valor Agregado por municipio año 2017- Base 2015. <https://www.dane.gov.co/index.php/estadisticas-por-tema/cuentas-nacionales/cuentas-nacionales-departamentales>
- [14] David Caldevilla Domínguez. 2019. Apuntes sobre M-learning y Realidad Aumentada: la nueva generación de TIC aplicadas a la docencia. *Areté* (Caracas, Venezuela), 5(10), 11–25.
- [15] Ministerio de Tecnologías de la Información y las Comunicaciones de Colombia [MinTIC]. (n.d.). Estadísticas Servicio de Comunicaciones/ telefonía móvil. <https://colombiatic.mintic.gov.co/679/w3-propertyvalue-47274.html>
- [16] Redacción Tecnósfera. (17 de julio de 2019). Colombianos tocan su celular 2 mil veces al día en estas actividades. *El Tiempo*. <https://www.eltiempo.com/tecnosfera/dispositivos/encuesta-de-consumo-movil-en-colombia-2019-389702>
- [17] Departamento Administrativo Nacional de Estadística [DANE]. 2018. Boletín Técnico Indicadores básicos de tenencia y uso de Tecnologías de la Información y Comunicación – TIC en hogares y personas de 5 y más años de edad. [https://www.dane.gov.co/files/investigaciones/boletines/tic/bo\\_tic\\_hogares\\_departamental\\_2018.pdf](https://www.dane.gov.co/files/investigaciones/boletines/tic/bo_tic_hogares_departamental_2018.pdf)
- [18] Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura [Unesco]. 2016. Educación para la Ciudadanía Mundial. Preparar a los educandos para los retos del siglo XXI. <http://unesdoc.unesco.org/%20images/0024/002449/244957s.pdf>
- [19] Rosario Gil-Galván, Inmaculada Martín-Espinosa, and Francisco Javier Gil-Galvan. 2020. Percepciones de los estudiantes universitarios sobre las competencias adquiridas mediante el aprendizaje basado en problemas. *Educación XXI*, 24(1). <https://doi.org/10.5944/educxx1.26800>
- [20] Instituto Tecnológico y de Estudios Superiores de Monterrey [Itesm]. 2000. Las técnicas didácticas en el modelo educativo del Tec de Monterrey. [http://sitios.itesm.mx/va/dide/docs\\_internos/inf-doc/tecnicas-modelo.PDF](http://sitios.itesm.mx/va/dide/docs_internos/inf-doc/tecnicas-modelo.PDF)
- [21] Omar Romero, Katiuska Fernández, and Sergio Ixmatlalhua. 2016. Propuesta de un modelo para la Implementación de un Sistema de Gestión del Conocimiento en la Educación Dual. *Tendencias de la Ingeniería de Software*. [https://www.researchgate.net/profile/Katiuska\\_Fernandez\\_Morales/publication/313988077\\_Propuesta\\_de\\_un\\_Modelo\\_para\\_la\\_Implementacion\\_de\\_un\\_Sistema\\_de\\_Gestion\\_del\\_Conocimiento\\_en\\_la\\_Educacion\\_Dual/links/58b0a7bda6fdcc6f03f60e77/Propuesta-de-un-Modelo-para-la-Implementacion-de-un-Sistema-de-Gestion-del-Conocimiento-en-la-Educacion-Dual.pdf#page=58](https://www.researchgate.net/profile/Katiuska_Fernandez_Morales/publication/313988077_Propuesta_de_un_Modelo_para_la_Implementacion_de_un_Sistema_de_Gestion_del_Conocimiento_en_la_Educacion_Dual/links/58b0a7bda6fdcc6f03f60e77/Propuesta-de-un-Modelo-para-la-Implementacion-de-un-Sistema-de-Gestion-del-Conocimiento-en-la-Educacion-Dual.pdf#page=58)
- [22] Observatorio Regional de la Sociedad de la Información de Castilla y León (ORSI). 2010. Herramientas para el Trabajo Colaborativo. Junta de Castilla y León.
- [23] Dawood Al Hamdani. 2013. Mobile Learning: A Good Practice. *Procedia -Social and Behavioral Sciences*, 103, 665-674. doi:10.1016/j.sbspro.2013.10.386
- [24] Carrie Fried. 2008. In-class laptop use and its effects on student learning. *Computers and Education*, 50, 906-914. doi:10.1016/j.compedu.2006.09.006
- [25] Jaume Carbonell. 2013. La aventura de innovar: el cambio en la escuela. *La aventura de innovar*, 1-124.
- [26] Jacqueline Hurtado. 1998. Metodología de la investigación holística. *Fundacite-SYPAL*.
- [27] César Bernal. 2010. Metodología de la Investigación para administración, economía y ciencias sociales. Pearson.
- [28] F. J. García-Peñalvo. 2014. Formación en la sociedad del conocimiento, un programa de doctorado con una perspectiva interdisciplinar. *Education in the Knowledge Society* 15, 1, 4-9. DOI:10.14201/eks.11641.
- [29] Alicia García-Holgado, Francisco J. García-Peñalvo, and María-José Rodríguez-Conde. 2015. Definición de un ecosistema tecnológico para la gestión del conocimiento científico en un Programa de Doctorado. En *Proceedings of the Third International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'15)* (Oporto, Portugal, 7-9 de octubre de 2015), G.R. Alves y M.C. Felgueiras Eds. ACM, New York, NY, USA, 695-700. DOI:10.1145/2808580.2808686