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ENHANCING A NEW DESIGN FOR "PRODUCT ENGINEERING" SUBJECT IN ORDER TO IMPLEMENT B-LEARNING

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ABSTRACT
Lecture recording and online pre-availability of lecture notes and slides is routinely at most universities. This means that Academia faces a wide challenge to ensure deep lecture content that is both engaging and accessible. This work presents the development of a new design for the course of "Product Engineering" implementing blended learning. This course is part of the Industrial Engineering and Management Program. During this course we had observed that students positively value the use of information and communication technologies during the lectures

INTRODUCTION
n the recent years, communication and information technologies have changed in a radical way, this has raised questions about how, why, when, or even whether, we should harness these technologies as way of teaching our students. Lecture recording, and ready availability of lecture notes and slides on-line is routine at most universities. Common practices at most Universities include nowadays lecture recording and providing on-line versions of lecture notes for the students to study at any time they think convenient. Learning management systems are just used by academics as file repositories, which get rolled over from one year to the next, with minor to no-change at all. In addition, stakeholders in education have been searching ways to design new software through technology-facilitated means [Oliver, 2005].This has led to a debate about the role more traditional presentation tools such as PowerPoint [Horvath & Lodge, 2015; Sørensen, 2015]. This means that Academia faces a wide challenge to ensure deep content that is both engaging and accessible. This gives Academia a wide range of options to choose from to ensure that the lecture content reaches the students in a clear, accessible and engaging manner. This can be addressed in many ways by developing interactive components that ensure learners can access key information, for example, simulations that immerse the learner in a real world situation [Escamilla, 2016].

The idea of enhancing the student learning experience has become more important in higher education since the mid-1990s due to increased student enrollment and diversification [Poon, 2013].

Blended learning (B-learning) is a common approach for using Information and Communication Technologies (ICTs) as a tool in the student's experience. The term "blended" means that traditional instructor-led training is being supplemented with electronic formats [Bersin, 2004]. This means a combination of face-to-face and online delivery methods, where the two components are complementing each other. B-learning integrates different training media, such as technologies, activities and events, to develop a training program for a specific audience.

In the Product Engineering subject the students identify the opportunities arising from an idea in order to develop a product and a business.

This paper presents the development of a new design for the course of "Product Engineering" implementing b-learning techniques. This course belongs to Industrial Engineering and Engineering Management Bachelor Program.

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MATERIALS AND METHODS

A. B-Learning Model(s) Used

There is a wide variance in the B-Learning practices, for example, Griffith's B-Learning Strategy identifies three modes of operation. Each mode indicates the level in the use of technology during the learning-teaching process [Bath, 2010]:

1. Technology is used in order to facilitate course management and resources for learner support.
2. Technology is used to improve the quality of the student learning experience through interactive learning activities beyond those attainable through face-to-face classroom interactions.
3. Technology is used to support learning that is largely self-directed but also involves the use of interactive and collaborative learning activities.

The International Association for K-12 Online Learning (iNACOL) have gathered 4 b-learning models [Darrow, 2013]. Here are included for completeness a short descriptions of such models:

a) Rotation Model: For a given course or subject, students swap- on a fixed schedule or when the instructor deemed necessary between different learning modalities and at least one of them must be e-learning based.

b) Flex Model: The lectures and tasks are delivered via ICTs before the face-to-face sessions. Students move on a previously set personal schedule among learning modalities. Meanwhile, the instructor delivers face-to-face help on a flexible basis.

c) A La Carte Model: Students take the course(s) fully online with an online teacher. Students may take the online courses either on or off campus.

d) Enriched-Virtual Model: Students split their time between attending to campus and distance learning.

Bersin [2004] classifies two main models of blended learning. These models can be broadly describe as:

a) Programed flow model: Learning activities are organized in a linear, sequential order and learners have deadlines to accomplish the various assignments.

b) Core-and-spoke model (e-learning or F2F): A major course is provided to the student and a set of supplemental materials are available to reinforce the main course; these materials are optional and not scheduled.

In the Product Engineering subject the students design and build a workteam by defining the required resources and abilities to develop and implement the new product and business. They also assess the value for the company of starting up and/or selling the project and obtain the necessary funds for their plans. Based on the Product Engineering syllabus and target audience we choose a "Rotation Model" in a sequential order, in this model ICTs are used to improve the quality of the student learning experience with interactive.

B. Learning Model Objects

Based on the course syllabus, the "learning objects" should have the following characteristics:

- target specific objectives
- short extension

The assessment procedure itself should be part of the learning object [Ortiz, 2004] and should include a tutorial for the student. This tutorial must include the description of the activities to do and how to do them. This means that course resources and learning-teaching activities must support students achievement of the previously stated learning objectives while assessment tasks shall be congruent with the activities and the objectives. In addition, they need to allow students to demonstrate those learning objectives were achieved. All of the above is called "constructive alignment" [Biggs, 1999].

C. Student engagement

The "student engagement" concept has been explored in the context of student learning, where it was observed a strong relationship between persistence, engagement and positive learning outcomes [Carini, Kuh & Klein, 2006; Krause, 2005; Pascarella & Terenzini, 2005]. Krause [2005] proposes ten principles to enhance student engagement within a university setting:

1. Create and maintain a stimulating intellectual environment
2. Value academic work and high standards
3. Monitor and respond to demographic subgroup differences and their impact on learning and teaching
4. Ensure expectations are explicit and responsive
5. Strengthen social networks
6. Acknowledge the challenges
7. Provide targeted self-management strategies

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8. Use assessment to shape the student experience and encourage engagement
9. Manage online learning experiences with care
10. Recognize the complex nature of engagement in your policy and practice

Together with Biggs' [2003] constructive alignment model, the above principles guided the course redesign of Product Engineering, the significant feature of which is the integration of technology to learning and teaching.

D. Implementation

The redesigned course was implemented in spring 2014 term, which integrates 29 hours work-based learning, complemented by web-based facilitated instruction for students studying off campus. The students take the subject in 8th term of their undergraduate program.

E. Assesment

Table 1 provides a snapshot of the learning tasks and assessment used in the course. As it can be seen in the table, the students have to engage in the learning activities.

Table 1: Learning activities and assessment for work-based learning

Learning activities	Assessment
Making a video about the history of the product	Rubric
Interviewing an entrepreneur	Self assessment
Developing a flowchart	Portfolio
Team sketch models	
Finding the sources for their product	
Product prototype	
Business Plan - Step-by-Step	
Design for manufacture	
Final prototype	
Final presentation	

RESULTS AND DISCUSSION

Out of the total of 32 sessions of the Engineering Product course we prepared 13 using ICTs, particularly using BlackBoard™. These 13 sessions spammed over the full course, and had the same structure which can be summarized as: Previous Readings, video, quizzes and activities. During presential sessions, the teacher provides an overview of the topic, after which the students make a preliminary reading of the contents through programming activities such as making videos or presentations. The learner is guided through scaffolded activities, discussions, opportunities for reflection, self-test quizzes, and extra activities if needed or desired. Figure 1 shows a section of the schedule of the course, where it can be seen the virtual sessions and delivery dates.

Development activities are pre-determined by the course designer (professor and a pedagogical assistant), the assessment tasks as many as possible and they consider, real-world activities where the students can demonstrate their abilities and outcomes. These activities generally include documentary research, production of videos, and industrial visits.

All of the learning activities are connected to the module progression. The learning objects were integrated with the content of the course, and are complement to face-to-face sessions.

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The objectives of the lesson were clear to students, and the sequence of the lesson was structured to build understanding and maintain a sense of purpose, so it was established a clear sequence for engagement in contents, activities and assessment tasks. Figure 2 shows the "welcome " of the course, where the students can check the course syllabus.

SEMANA	TEMA	ACTIVIDAD	MODALIDAD	FECHA DE ENTREGA
Semana 1 Del 11 de enero al 15 de enero	Tema 0 Presentación	11 de enero Introducción a la materia – lineamientos. Capacitación de Blackboard	En el aula	–
	Tema 1 Estimulando la creatividad	11 de enero Imágenes y sorteo de equipo de presentación	En el aula	
	Tema 1 Estimulando la creatividad	13 de enero Actividad 1. Video – Origen del producto Realizar presentación en video del tema sorteado	Virtual en equipo	20 de enero 23:59 h
Semana 2 Del 18 de enero al 22 de enero	Tema 2 Origen de las ideas	18 de enero Emprendedores y mitos	En el aula	–
	Tema 2 Origen de las ideas	20 de enero Actividad 2a. Entrevista a un emprendedor Videos de emprendedores, similitudes y cómo fueron consolidando la idea a futuro.	Virtual en equipo	27 de enero 23:59 h

Fig. 1: Schedule example.

Biggs [2003] proposes that the principles supported in constructive alignment should aid the active engagement of the students. Figure 3 illustrates an example of constructive alignment in practice, which shows the introduction for a new topic and Figure 4, shows the assessment activity that demonstrates the link to a particular learning outcome.

Figure 4 shows activities 5a, 5b and 5c, which implements the chosen model.

Activity 5a:

- Aim: To make an analytical prototype
- Learning activity: In a CAD software (Autocad™ , Solid Works™, or ProEngineer ™) make an analytical prototype
- Hint: Identify requirements, evaluate alternatives and analyze the product's operation

Activity 5b:

- Aim: To define the requirements
- Learning activity: Make a list of all the possible resources in which you think you can find useful. Now mark the sources on your list that you will most likely be able to use, given the time and sources you have available. Give them a prioritized number order for which you will use first, which second and so on
- Hint: Identify location, evaluate alternatives and analyze the functionality of resources

Activity 5c:

- Aim: To make a physical prototype
- Learning activity: Build an evolutionary prototype
- Hint: You have to show the initial prototype

All the activities shows the constraints and due dates, also the delivery information.

The previous activities illustrate the model: It was established a clear sequence for engagement in contents, activities and assessment tasks.

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Bienvenida

Me imagino que alguna vez te has hecho algunas preguntas como:

- ¿Cuántas veces has pensado en innovar el mundo?
- ¿Has deseado modificar algún producto y lanzarlo a la industria?
- ¿Crees tener el conocimiento necesario para desarrollar un producto?

Estás en el lugar y momento adecuado, ya que, durante este semestre tendrás la oportunidad de **aprender el proceso de desarrollo de productos**: identificando oportunidades, aterrizando tu idea, trabajando en equipo, determinando los recursos necesarios para hacer realidad la visión; y así, generar fuentes de empleo para el progreso de la sociedad.

Objetivos del curso / Resultados de aprendizaje

El alumno:

1. **Identifica una oportunidad** a través de una idea para generar un producto y/o empresa.
2. **Diseña y construye un equipo de trabajo** con las habilidades para hacer realidad la visión del nuevo producto y/o empresa, determinando los recursos necesarios.

Políticas generales del curso

LINEAMIENTOS

1. La tolerancia para entrar al salón de clase es de **5 minutos**.
2. El alumno deberá cumplir con el **80%** de asistencia.

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Kelley Tom
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Fig. 2: Course syllabus.

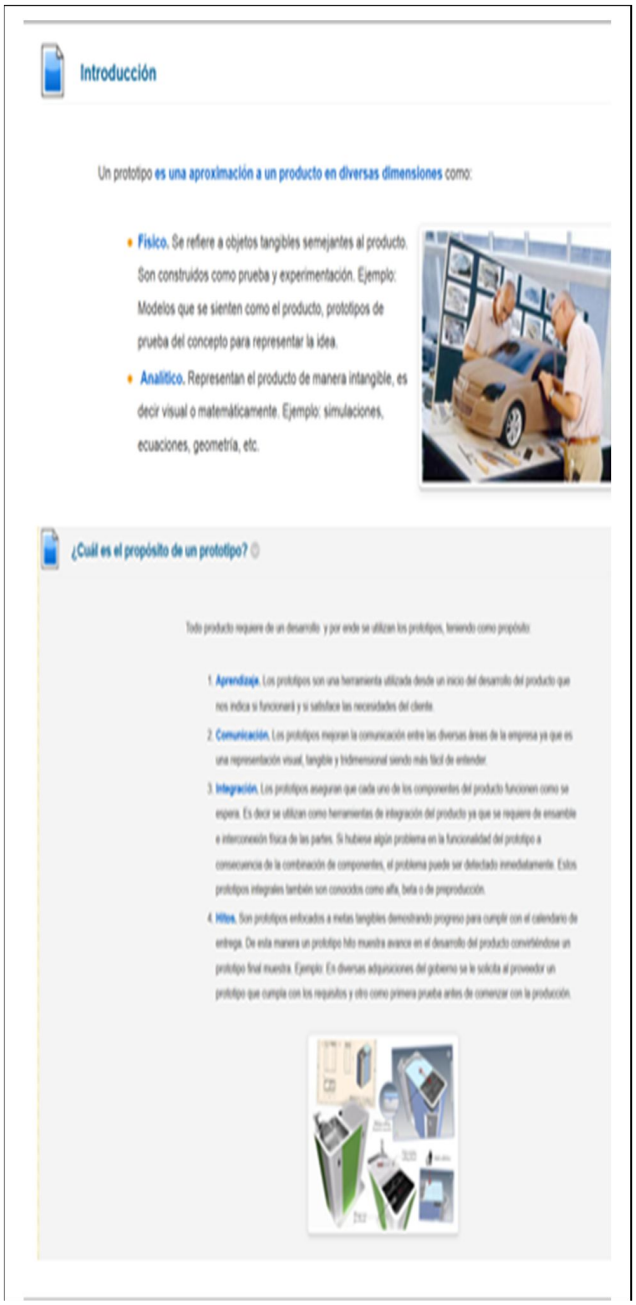

Fig. 3: Brief course content.

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Fig. 4: Example of learning activity

CONCLUSION

The described lesson design was used as a strategy to develop learning opportunities for a wide group of students. The first aim was to build an environment where the learning tasks were not so easy that the learners became bored. On the other hand the activities were sufficiently challenging and motivating but within reach. This design stimulated students to work through difficult tasks with support from teachers and peers.

When technology is used, it should increase the potential for learning, and not be used simply for its own account. Effective practice in b-learning requires selecting the most appropriate tools for the purpose.

It is necessary realizing that the implementation of effective teaching and learning — whether face-to-face, blended or online — never ends.

The new of the course Product Engineering along engagement principles [Krause, 2005] lead to significantly increased student interaction, engagement with learning and assessment tasks, and achievement of higher order outcomes.

In the other hand the lecturers should consider:

- The need for becoming more comfortable with ICT and learn how to incorporate it into their teaching practice
- The need for shift from the broadcast model (lecturing and focusing on facts) to a learner-centric model
- The need for engaging the students in a highly interactive and connected learning environment

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It means, that educators need to create new learning environments that will prepare students for collaborative learning in a global, authentic learning environment

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