

## A Flipped Learning Agile Methodology for teaching in higher education levels

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### Abstract

*This paper presents the results of implementing the Flipped Learning Agile (FLA) methodology as a general framework to manage courses and to encourage proactive learning for students in higher education levels. Flipped Learning is used in combination with Information and Communication Technologies (ICTs) to encourage the student in the self-learning process. It is proposed the integration of an Agile Methodology that includes the use of Scrum and Kanban methodologies, by means of sprints for task scheduling and using a board for activities status, into a Flipped Learning (FL) environment. The proposed FL environment is composed of applications such as YouTube, Google Classroom, and Google Drive. The Scrum methodology was designed for 4 sprints, each one for a week-long. Before applying the FLA methodology, a Motivated Strategies for Learning Questionnaire (MSLQ) was applied in a group of Electrical Circuits students at the University of Guadalajara. To examine the self-regulated learning process, the performance of the students was analysed before applying the FLA methodology; the same MSLQ was carried out after implementing the FLA methodology. The analyses of the last MSLQ show that the implementation of the FLA methodology, by means of the integration of the Agile methodologies of Scrum and Kanban into a flipped learning environment, encourage the self-learning strategy for higher education level students.*

**Keywords:** *Flipped Learning, Agile Methodology, Scrum, Kanban, Learning strategies, sprints, Peer-learning.*



## 1. Introduction

Agile methodologies have improved project development in the industry. The Agile Manifesto (Schwaber, 2004) settled down a development paradigm introducing Scrum and Kanban methodologies (Maximini, 2015; Stellman & Greene, 2016) leading to a faster and more efficient project management. Scrum frameworks allow the completion of complex projects by dividing them into small time-lapsed tasks called *sprints* (Tracy, Frog, & Power, 2014); while Kanban boards are meant to organize these tasks into a categorized status list of activities in the form of a planned task board (Hammarberg & Sundén, 2013; Leopold & Kaltenecker, 2015).

Agile methodologies have probed to improve project management in software engineering fields (Ahmad, Dennehy, Conboy, & Oivo, 2018) as well as in product-service systems (Hernandez, Version, & Hernandez, 2019). Recently, *Industry 4.0*, which can be defined as the integration of *Internet of Things*, *Big Data* and *Artificial Intelligence* into traditional industry (Vaidya, Ambad, & Bhosle, 2018; Xu, Xu, & Li, 2018), has started to make an extensive use of agile methodologies (Cakmakci et al., 2019).

There are also efforts for applying agile methodologies in Education fields. In the work of (Fernanda et al., 2018), a case of study in Universidad Técnica Particular de la Loja in Ecuador, is presented to apply agile methodologies in their teaching-learning process for engineering. Authors present a scrum based framework to plan, develop and follow-up academic activities. As a result, their students became more efficient and self-satisfied, with a higher interaction level in teamwork, as they were actively involved in more stages of the teaching-learning processes than in the traditional method. Also in (Fernanda et al., 2018) is presented an adaptation of the Agile Manifesto principles into the Academic field. Other authors have explored the potential, and evaluate the benefits, of agile methodologies and lean concepts to design teaching units, as (Judd & Blair, 2018) presented in their case of study for an Australian university which adopted these strategies. They found that peer-learning was encouraged in students. Peer-learning is a process where students are stimulated to collaborative learning and efficient teamwork (Nielsen, Johansen, & Jørgensen, 2018). As in agile methodologies is needed to work in teams, peer-learning becomes very important.

There are many instruments to encourage peer-learning. Recently *Information and Communication Technologies* (ICTs) had led to a *Flipped Learning* classroom environments for individual and collaborative online work. The authors in (Basoo-Aránguiz, 2018) present a variety of online tools, like *Google Classroom*, *YouTube*, *Google Drive*, as a technological framework for a *Flipped Learning* (FL) environment



methodology to promote peer-learning and self-regulated learning strategies (Broadbent & Poon, 2015).

In this paper, it is presented a combined *Flipped Learning* and *Agile* (FLA) methodology applied to a case of study for a final project in a group of students for the course of Applied Electrical Circuits at the Universidad de Guadalajara, México. Improvements in student performance were measured by applying a Motivated Strategies for Learning Questionnaire (MSLQ) before and after implementing the FLA methodology.

The objectives of this work are as follow:

- To apply an FL environment to academic activities for a higher education level assignments.
- To apply the Agile methodology, the Scrum framework, and Kanban boards, for the student's activities.
- To obtain and analyze students self-learning and motivational learning beliefs indicators before and after applying the FLA methodology.

## 2. Research methodology and implementation

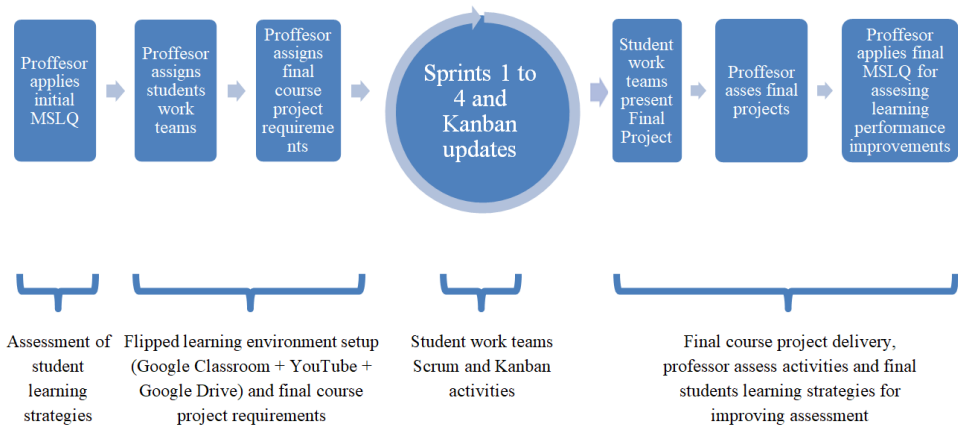
The methodology used is based on a Flipped Learning (FL) environment as presented (Basoo-Aránquiz, 2018), using the online Google Classroom suite as the course management platform, where the professor can publish and evaluate assignments as well as course additional material publishing. Also YouTube and Google Drive were incorporated into the Flipped Learning environment model presented. The inclusion of Agile methodologies was implemented by means of a Scrum framework and a Kanban board for the final course project. The student's performance is evaluated by a *Motivated Strategies for Learning Questionnaire* (MSLQ) before and after the FLA is implemented. As a case of study, the methodology was applied for 4<sup>th</sup>-semester students of Engineering in Energy at the Universidad de Guadalajara in the Applied Electric Circuits course. The student's group was composed of 23 students (18 men and 5 women aged 19 to 31 years old).

The Applied Electric Circuit course program is divided into five thematic units. For the case of study, in order to apply the FLA methodology, it is proposed a new sixth unit to integrate the Scrum framework and Kanban board as well as the MSLQ as a student's self-regulated learning strategies and motivational beliefs assessment.

Tools in face-to-face lectures and online work, such as Google Classroom, Google Drive and YouTube, were used as a flipped learning environment to accomplish the Scrum



framework and Kanban boards tasks. Figure 1 shows the FLA methodology adaptation proposed for academic fields.



*Fig. 1 Flipped Learning Agile Methodology proposed for academic field.*

The MSLQ, as propose (De Groot & Pintrich, 1990; STEM Learning and research center, 2018), was applied at the beginning of thematic unit six and before implementing the FLA methodology in the student's group. Figure 2a shows the MSLQ students register form and Figure 2b shows the MSLQ 0 to 7 questions to carry out the assessment.

**Motivated Strategies for Learning Questionnaire**

\*Obligatorio

**Sección sin título**

Apellido paterno \*

Apellido materno \*

Nombre(s) \*

Género \*

Hombre

Mujer

Prefero no decirlo

Edad \*

Prefiero el trabajo de clase que es retador, de tal manera que aprendo cosas nuevas \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Comparándome con otros alumnos de esta clase, yo espero tener un buen desempeño \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Suelo estar muy nervioso durante los exámenes, de tal manera que no puedo recordar cosas que he aprendido \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Para mí es importante aprender lo que se enseña en esta clase \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Me gusta lo que estoy aprendiendo en esta clase \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Estoy seguro de que yo puedo entender las ideas enseñadas en este curso \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Fig. 2 MSLQ online form, (a) shows the student register and (b) the applied questions

After applying the MSLQ, professor publishes, by means of Google Classroom, the final project requirements and assessment policies. Then student’s teams start to work in their own activities using the Scrum framework and Kanban board for scheduling the tasks. After finishing each sprint, students must update their Kanban board. Figure 3 shows an example of Kanban board implemented by a student’s team.

MACETA INTELIGENTE 2019						
PENDIENTES	FECHA DE COMIENZO	FECHA DE VENCIMIENTO	EN PROGRESO	% COMPLETADO	COMPLETADO	NOTAS
conseguir materiales	10/04/19	03/05/19		100%	<input checked="" type="checkbox"/>	electronicos
conseguir materiales	10/04/19	03/05/19		100%	<input checked="" type="checkbox"/>	para maceta
realizar el diagrama	10/04/19	03/05/19	realizar el diagrama	75%	<input type="checkbox"/>	
simular circuito	10/04/19	03/05/19		0%	<input type="checkbox"/>	
hacer maceta	10/04/19	03/05/19	hacer maceta	75%	<input type="checkbox"/>	
armar maceta	10/04/19	03/05/19	armar maceta	25%	<input type="checkbox"/>	
comprobar maceta	10/04/19	03/05/19		0%	<input type="checkbox"/>	
programar arduino	10/04/19	03/05/19		100%	<input checked="" type="checkbox"/>	
armar filamento	10/04/19	03/05/19		100%	<input checked="" type="checkbox"/>	
conseguir planta	10/04/19	03/05/19		100%	<input checked="" type="checkbox"/>	
hacer calculos	10/04/2019	03/05/2019	hacer calculos	25%	<input type="checkbox"/>	por el momento se ha complicado

Fig. 3 Kanban board implement by a team of students

After all Scrum sprints were completed and the final project delivered, it was applied an MSLQ again to evaluate the students self-regulated learning strategies improvements. Table 1 shows how questions of the MSLQ evaluates the students learning components.

**Table 1 MSLQ learning components index assessment**

	Learning component	Questionnaire
Motivational Beliefs	Self-Efficacy	2, 7, 10, 11, 13, 15, 20, 22, 23
	Intrinsic Value	1, 5, 6, 9, 12, 17, 18, 21, 25
	Test Anxiety	3, 14, 24, 27
Self-Regulated Learning Strategies	Cognitive Strategy Use	30, 31, 33, 35, 36, 38, 39, 42, 44, 47 53, 54, 56
	Self-Regulation	32, 34, 40, 41, 43, 45, 46, 52, 55

Using the learning components presented in Table 1, it is possible to assess the students self-regulated learning strategies and their motivational beliefs. A higher index in self-efficacy, intrinsic value, cognitive strategy use, and self-regulation is desired.

### 3. Results and discussion

A comparison of the results between the first and the last MSLQ (for motivational beliefs and self-regulated learning strategies) was carried out, as shown in Table 2.

**Table 2 MSLQs results and its learning components rate change ( $\Delta$ )**

Strategy	MSLQ component	1 <sup>st</sup> MSLQ group results	2 <sup>nd</sup> MSLQ group results	$\Delta$
Motivational beliefs	Self-efficacy	5.51	5.70	+0.19
	Intrinsic value	5.49	5.64	+0.15
	Test anxiety	5.34	5.54	+0.20
	Mean value	5.45	5.63	+0.18
Self-regulated learning	Cognitive strategy use	5.00	5.41	<b>+0.41</b>
	Self-regulation	4.90	5.35	<b>+0.45</b>
	Mean value	4.95	5.38	+0.43

Agile methodologies and flipped classroom framework allowed the students to improve their self-regulated learning strategies, as well as their motivational learning beliefs as shown in Figure 4.

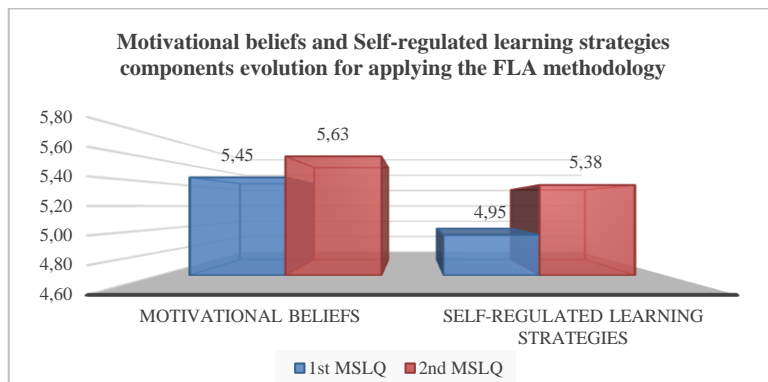


Fig. 4 Motivated Strategies for learning evolution after applying FLA methodology

According to results in Table 2, improvements in self-regulated learning strategies were noticed, changing the score from 4.95 to 5.38 points. While a less significant change was noticed in motivational beliefs strategies, scored from 5.45 to 5.63 points. About specific learning components, “*self-regulation*” score increases from 4.90 to 5.35 points. “*Self-regulation*” is related to an improvement in how students transform mental abilities in task-related skills (Zimmerman, 2001). “*Cognitive strategy use*” score increase from 5.00 to 5.41. “*Cognitive strategy use assesses*” how students learned to use new tools presented (Kauffman, 2004).

#### 4. Conclusions

This paper presents the FLA methodology framework and its implementation results in a case of study for a student’s group at the University of Guadalajara, México. Results of applying FLA methodology show that the method acts mainly on the self-regulated learning strategies and its related learning components. Main advantages obtained after applying FLA methodology are:

- Professors can improve significantly the *self-regulated learning strategies* in their students.
- Students increase self-confidence using the Scrum framework and the Kanban board improving their *learning self-regulation*.

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