



Influence of learning objects in the implementation of the flipped classroom

Influencia de los objetos de aprendizaje en la implementación del aula invertida

Influência dos objetos de aprendizagem na implementação da sala de aula invertida

Johanna Salamanca¹

Universidad Pedagógica y Tecnológica de Colombia, Tunja - Boyacá, Colombia

 <https://orcid.org/0000-0002-2128-9726>

berta.salamanca@uptc.edu.co

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KEYWORDS

flipped learning, flipped classroom, students, motivation, learning objects, critical thinking.

ABSTRACT. This article aims to present a systematic review of the literature that addresses the methodological implementation of the flipped classroom and its relationship with the different learning objects used in this interactive space. From this review, it was investigated the use of these objects in the classroom with the motivation and academic performance of the students. The methodology used in this study was the documentary review of 30 articles published in different scientific databases. Studies were analyzed in the period between 2015 and 2020, which allowed concluding the application of different learning objects simultaneously had a positive influence on student motivation. It should be further clarified academic performance tends to increase applied learning objects indistinctly.

PALABRAS CLAVE

aprendizaje invertido, aula invertida, estudiantes, motivación, objetos de aprendizajes, pensamiento crítico.

RESUMEN. Este artículo tuvo como objetivo presentar una revisión sistemática de la literatura que aborda la implementación metodológica del aula invertida y su relación con los diferentes objetos de aprendizaje utilizados en este espacio interactivo. A partir de esta revisión, se indagó sobre la relación del uso de estos objetos en el aula con la motivación y el rendimiento académico de los estudiantes. La metodología empleada en este estudio fue la revisión documental de 30 artículos publicados en diferentes bases de datos científicas. Se analizaron estudios realizados en el período comprendido entre 2015 y 2020, que permitieron concluir que la aplicación de diferentes objetos de aprendizaje de manera simultánea influye de forma positiva en la motivación de los estudiantes. Cabe aclarar adicionalmente, que el rendimiento académico tiende a incrementar indistintamente de los objetos de aprendizaje aplicados.

PALAVRAS-CHAVE

aprendizagem invertida, sala de aula invertida,

RESUMO. Este artigo teve como objetivo apresentar uma revisão sistemática da literatura que aborda a implementação metodológica da sala de aula invertida e sua relação com os diferentes objetos de aprendizagem utilizados neste espaço interativo. A partir desta revisão, investigou-se a

¹Degree in technology and master's degree in ICT applied to educational sciences. **Correspondence:** berta.salamanca@uptc.edu.co



alunos, motivação, objetos de aprendizagem, pensamento crítico.

relação do uso desses objetos em sala de aula com a motivação e desempenho acadêmico dos alunos. A metodologia utilizada neste estudo foi a revisão documental de 30 artigos publicados em diferentes bases científicas. Foram analisados estudos realizados no período entre 2015 e 2020, o que permitiu concluir que a aplicação de diferentes objetos de aprendizagem simultaneamente influencia positivamente na motivação dos alunos. Deve-se esclarecer ainda que o desempenho acadêmico tende a aumentar independentemente dos objetos de aprendizagem aplicados.

1. INTRODUCTION

Education has evolved over time; it has influenced the improvement and emergence of new theories, pedagogical models, methodologies, techniques, even the incorporation of technological resources. A clear example of this is the active methodology known as the flipped classroom (Cantuña & Cañar, 2020).

This methodology proposes a break in pedagogy by defining itself as "a teaching method where the student assumes a much more active role in the learning process than the traditional one" (Berenguer, 2016, p. 1466). This involves a leading role of students in the teaching-learning process, where they learn by themselves the theoretical concepts provided by the teacher during class time. It will be used to resolve doubts, perform practices and initiate relevant discussions on the previewed content (López et al., 2020)

In addition, this method allows the acquisition of basic skills such as self-learning, collaborative work and critical thinking, it leads to a real paradigm shift: from teacher-centered learning to student-centered learning (Servicio de Formación en Red. INTEF, 2014).

According to literature search reviews, the most referenced authors as precursors of this methodology are Bergmann and Sams, cited and confirmed by Pavanelo and Lima (2017), expanded by Neto and De Lima (2017) and Lastayo et al. (2018). The sources indicate that these two authors started with the inclusion of video as the only learning object, understanding the concept of learning object as any type of digital educational material which forms an autonomous unit, it achieves a certain educational objective which combined with other learning objects can lead to the construction of more complex structures, such as lessons, modules or courses (Garzón et al., 2019). However, the flipped classroom pioneers recognize one of the big mistakes they made at the beginning was to focus on video, so now they use the term learning objects to include other objects besides video, such as online simulations, books and newspapers (Berenguer, 2016).

Currently, there are systematic review studies focused on analyzing the influence of flipped classroom with academic performance (Escudero & Mercado, 2019; Hinojo et al., 2019; F. Rodríguez et al., 2021). However, there are few studies related to motivation, despite it is a key factor to consider in the teaching and learning process, since its intention is to create sense and desire in students to perform an activity (Alemán et al., 2018). This gap should be addressed and explored in the research field, motivation is a determining criterion to implement the flipped classroom, considering students are delegated the autonomous work of previewing the contents with the purpose of strengthening their self-learning and this is directly linked to the desire to learn or perform an activity. It means the motivation degree of the actors involved is influenced by the interaction with the learning objects; it is not an ability explicitly stated in the research works (Sandobal et al., 2021).

The main goal of this article is to present a systematic literature review, which addresses the issue of learning objects used in the implementation of the flipped classroom. Taking into account this review a parallel was made between video and multimedia materials to establish their influence on motivation and academic performance.

The resources analyzed are those provided by the teacher beforehand; therefore, the student arrives to the classroom with extra previous knowledge.

2. METHOD

The following stages on table 1 were followed to develop the systematic literature review.

Table 1

Stages to elaborate a bibliographic review.

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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Define the objectives of the review. • Conduct the literature search. <ul style="list-style-type: none"> - Search of databases and documented sources. - Establishing the search strategy. - Specify the criteria for selecting the documents. • Organize the information. • Write the article |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Note: Required diagram to prepare a bibliographic review. Source: Girao, et al. (2007, as cited in Vera, 2009).

Databases such as Scopus, Google Scholar, Dialnet, Scielo, Redalyc and the Mendeley search engine were used to do the literature review. The search strategy was focused on two affinity criteria; the first one had to include in the title one of the following terms: flipped classroom or flipped learning and the second one referred to the year of publication; it had to be between 2015 to 2021. The records obtained belong to 60 articles, with greater textual production from 2020 and 2021. The most cited countries are: Spain and Colombia.

Once the information was filtered, 30 of the 60 studies were excluded due to they were review articles, which prevented us from evaluating the learning objects. However, some of them were used as theoretical support.

Table 2

Universe, core and studies sub core.

Study Universe	Study core	Studies sub core
Learning objects in the flipped classroom, a systematic review.	Characterization of learning objects to implement the flipped classroom.	<ul style="list-style-type: none"> - Videos - Performance - Readings - Podcast - Simulator. - Interactive activities and educative games. - Diagrams - Others

Analysis by category.

- Motivation
- Academic performance

Source: own elaboration.

Table 3

Systematization of information on characterization of learning objects.

Number	Author	Learning objectives							
		Videos	Performance	Readings	Podcast	Simulator	Interactive activities and educative games	Diagrams	Other
1	Hidalgo et al. (2021)	x		x			x		Forum
2	Flores et al. (2021)	x							
3	Almendros et al. (2021)	x	x						Problems and case studies
4	Falcón et al. (2020)	x		x					
5	M. Rodríguez et al. (2020)	x							
6	Friss y Adorjan (2020)	x		x			x		Rubrics
7	Espada et al. (2021)	x							
8	T. Hernández et al. (2019)	x	x				x		
9	C. Sánchez et al. (2019)	x							
10	Arango (2018)	x				x			
11	Ccoyllo y Rodríguez (2017)	x			x		x		Class craft
12	Ros y Rodríguez, 2021)	x	x				x		
13	Ordoñez et al., 2021)	x	x	x			x		Rubrics
14	Guillén et al., 2020)	x	x						
15	Pavanelo y Lima, 2017)	x							
16	C. Hernández y Tecpan (2017)	x	x	x			x		
17	Acevedo et al. (2019)	x				x	x		Rubrics
18	Borao y Palau (2016)	x		x				x	
19	Veytia et al. (2019)	x							
20	Tallei (2017)	x							
21	Madrid et al. (2018)	x							
22	R. Sánchez (2017)	x							
23	Recio (2017)	x							



24	Ofugi y Figueredo (2017)	x					
25	Barros y Martínez (2018)	x					
26	Matzumura et al. (2018)	x	x	x	x		Forum
27	Pereira y Fernandes (2018)	x	x	x		x	Facebook
28	Fornons y Palau (2016)	x					
29	Domínguez y Bobkina (2018)	x					
30	Salas (2021)	x					

Note. Systematization table on characterization of the central object from each article in the literature review.
Source: Own elaboration.

3. RESULTS

3.1. Characterization of learning objects on the implementation of the flipped classroom.

Regarding table 3 two categories were established for the previous use of learning objects in the flipped classroom methodology. The first one refers to the exclusive use of videos and the second one to the use of multimedia material, including readings, podcasts, simulators, interactive activities, educational games, diagrams and others. Subsequently, their content was analyzed to place them in each category.

While classifying the information, the 50% of the studies use video as the only learning object in the implementation of flipped classroom and the other 50% make use of multimedia material.

3.1.1 Category 1 videos

Table 4

Systematization of information on the use of video.

Author	Motivation Analysis and Academic Performance
Flores et al. (2021)	The research was focused on the perception of methodology, rather than academic performance. The results show students felt comfortable using educational platforms. However, they expressed inconvenience in phase 2, since they did not have enough time to fully preview the contents and discuss them in class.
M. Rodríguez et al. (2020)	The study showed students strengthened their knowledge to plan and implement specific activities and procedures to the nursing disciplinary area. In addition, they were able to overcome "the fears of performing a practice in an unfamiliar environment, it lets the student to be motivated by learning as a vehicle to overcome those fears, and to develop a practice strengthened by the broad knowledge of the aspects" (p.321).

- Espada et al. (2021) Both in academic performance and motivational aspect, "there are hardly any differences between students who have received the intervention through the traditional method and those who have followed the flipped classroom method" (p. 223). It was evidenced a slight increase in social interaction.
- C. Sánchez et al. (2019) Students believe they make better use of time and it improves their learning and content understanding. Additionally, it generates motivation in the students by allowing them to manage their learning speed and encourages them to participate more frequently in class.
- Pavanelo y Lima (2017) It was identified "the decisions taken for this experience were not satisfactory, it had to rethink its structures, contents and technologies" (p.757). This study showed the relevance of performing correct content selection, since the poor selection of material affect negatively the motivation students initially had to learn the methodology.
- Veytia et al. (2019) It was possible to attract the students' attention using the recording of videos given by the teacher with theoretical and practical content, to have a better understanding of the topics. However, improving the quality of the videos and the inclusion of more activities inside and outside the classroom was mentioned as a necessary aspect to obtain better results in a future implementation.
- Tallei (2017) The videos supported the understanding of the contents. Although, they initially contributed the students' approach to their digital culture, over time their interest waned due to the monotony and simplicity of the provided material.
- Madrid et al. (2018) This descriptive analysis looked into the effectiveness of the method to improve high school mathematical skills. The results revealed no differences between the experimental and control groups. The study mentions 11 possible factors that lead the students' lack of motivation.
- R. Sánchez (2017) There are academic benefits in the foreign language; however, the motivational component is affected by 63%. They expressed disagreement with the videos, although for some students it was useful and easy to understand.

Recio (2017)	The implementation of this methodology was different from all others, since students were the ones who created the videos under the teachers' supervision. The study shows at the beginning there was dissonance among the students. However, the final results do not indicate whether this aspect improved or remained the same. Finally, it was found an improvement in the understanding of the subject.
Ofugi y Figueredo (2017)	The study developed autonomy in learning English. It indicates satisfactory achievements. However, there is no mention of the motivational component.
Barros y Martínez (2018)	Significant improvements of 95 % are evidenced in the subject of Algebra IV, although during the implementation they showed difficulties to adapt themselves to the methodology.
Fornons y Palau (2016)	"Academic results have improved compare to those obtained through the traditional methodology and students have increased their performance in Math". (p.16).
Domínguez y Bobkina (2018)	"The results showed the use of mini-videos in the flipped classroom, as Learning Objects, it is an excellent support in the teaching-learning process" (2018). In addition, they valued very positively the visualization and explanation of different mini-videos.
Salas (2021)	"The search of videos on YouTube evidences positively influences on students' motivation during the learning process about Karnaugh maps before class" (p. 3), the research hypotheses were accepted.

Source: Own elaboration.

3.1.2 Category 2. Multimedial Material

Table 5

Systematization of information on the use of multimedia material.

Author	Motivation Analysis and Academic Performance
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- Hidalgo et al. (2021) The strategy allowed the development of research competencies and students reflect satisfaction by implementing multimedia objects, since they find it useful, it is connected to reality for their professional life.
- Almendros et al. (2021) In this research they worked with a control group and an experimental group. The experimental group results were satisfactory, since the displacement of the Gaussian curve showed higher academic performance and it was evidenced they were more motivated.
- Falcón et al. (2020) The quasi-experimental research presented showed an improvement in the understanding of theoretical concepts of Event Management and Organization in Physical Activity and Sport Sciences. It also favored motivation and other positive consequences.
- Friss y Adorjan (2020) "Similar values were obtained in previous Programming II courses and also high motivation and engagement. Compliance was maintained with the flipped format that was used throughout the year" (p.1).
- T. Hernández et al. (2019) The use of the flipped classroom "has greatly contributed to the acquisition of new phraseological competence (in addition to the general linguistic and communicative competence) according to results obtained". In addition, 70% of the materials are very motivating and 30% are quite motivating, "increasing motivation and avoiding boredom"
- Arango (2018) Taking into account the 7 aspects assessed, it was obtained an improvement in academic performance relate to production programming techniques. It was verified an improvement in the motivational component In the qualitative evaluation of the preliminary tests.
- Ccoyllo y Rodrigue (2017) Incorporating game mechanics called gamification and flipped classroom methodology into an online virtual classroom environment helps improve academic performance. In turn, it increased student satisfaction on the course and increased motivation by evolving their Class Craft characters.
- Guillén et al. (2020) "The results showed meaningful differences between student attitudes, the pre-test and post-test when using this methodology." (p.121). However, no mention

	is made of students' academic performance since their study did not have this focus.
Ros y Rodríguez (2021)	There was an improvement in the concept level attained by students; an increase in active participation in the classroom, and a higher level of student motivation.
Ordoñez et al. (2021)	Learning benefited at a high cognitive level, and student engagement improved.
C. Hernández y Tecpan (2017)	The study was applied with future physics teachers. It was evidenced a meaningful learning of knowledge and increased motivation by a high percentage of students.
Acevedo et al. (2019)	There is evidence of an improvement in financial culture, specifically in financial market issues. Increased motivation is associated with a higher level of participation.
Borao y Palau (2016)	The flipped classroom approach has been shown to improve student learning outcomes. It went through the requirements in each of the three aspects of concepts, procedures and attitudes.
Matzumura et al. (2018)	The implementation was carried out by an external researcher in the classroom. Satisfactory results were evidenced in the improvement of academic performance. However, resistance to the methodology was perceived, both by teachers and students.
Pereira y Fernandes (2018)	"It turned out to be a very enriching strategy for the students who participated in the process. The proposal fulfilled one of its objectives,"(p.22). In addition, they showed interest in continuing to deepen their knowledge and demonstrated satisfaction with the applied method.

Source: Own elaboration.

4. DISCUSSION

The systematization of Tables 2 and 3 are allowed for a categorical analysis presented in Table 4 on the influence of learning objects in the implementation of flipped classroom on academic performance and motivation.

Table 6

Systematization of results analysis.

Criteria	Escale	Video	Multimedial resources
Academic Performance	No mention	6,7%	6,7%
	Same	20%	-
	Decrease	6,7 %	-
	Increase	66,6 %	93,3%
Motivation	No mention	6,7%	6,7%
	Same	20%	6,7%
	Decrease	40%	-
	Increase	33,33%	86,6%

Note. Systematization of results on the improvement of academic performance and motivation in the analyzed studies on the literature review. Source: Own elaboration.

Regarding academic performance criteria, an increase is evident regardless the learning object. However, it is more significant at 26.73% on multimedia resources.

This proves the importance of the second criteria, motivation. In the video category, there was a high percentage of decrease, due to there was not performed a correct content selection by most of the researches. This process involves searching, filtering, analyzing, editing, and disseminating information to optimize Internet resources (Juárez et al...2017). It is important to consider the visual tool should be adapted to the characteristics of population taking into account their interests and needs (Aguilera et al., 2017). The apathy present in students is due to the fact with the passage of time the video resource becomes boring and monotonous, despite its significant pedagogical contributions. It is necessary to adopt innovative attitudes (Pavanelo & Lima, 2017). For this reason, it recommends to include different learning objects for future research, such as readings, podcasts, simulators, to be consulted outside the classroom (Salas, 2021).

According to Ordoñez et al. (2021) the implementation of the flipped classroom "requires ICT, didactic platforms, web pages and sites, virtual visits to museums and places of geographical or historical interest, as well as materials, documents, questions, etc. in digital format, chat, e-mail," (p. 503). It is essential to consolidate relevant interactive materials for each purpose or area of interest. This is evident in the analysis conducted in the multimedia category.

To conclude motivation is a determining factor in the improvement of teaching. Multimedia resources are used to meet this objective since students find freedom to define their learning speed in the flipped classroom (Cedeño & Viguera, 2020). Likewise, it is demonstrated by the research of Zamudio et al. (2019) where it highlights students are motivated by the material presented in the virtual platform, since it allows them to reinforce the theory with the development of the multimedia presented.

Every teacher should keep in mind that videos and multimedia materials do not act as a replacement, they act as an evaluation bridge to obtain prior knowledge from students (Berenguer, 2016; Veytia et al., 2019). The main purpose for students is to develop in the face-to-face class, dynamic pedagogical strategies which allow them a more comprehensive learning according to the current time (Flores et al., 2021). Although this research



did not address it, it was looking for true innovation in the classroom. It is no useful to continue doing the same things during class time. This space should be used to strengthen the higher order thinking skills of the hierarchy of cognitive processes established in Bloom's taxonomy (Cuenca et al., 2021). It should be use at any educational level and subject, taking into account "the flipped classroom allows an interactive class with greater flexibility to adapt the learning experience" (Janssen, 2020).

5. CONCLUSIONS

Learning objects are fundamental to implement the flipped classroom, taking into account these are used by students to interact autonomously and generate prior learning. However, it is necessary to offer the student quality content to generate interest and motivation outside the classroom. Teachers who are not content creators are suggested to carry out a correct content selection.

Videos or video tutorials are the most used tool, they allow students to follow a sequence and go back to it any time to understand better the subject. However, doing something repetitively becomes tedious and monotonous, for this reason, it is necessary to conceive other multimedia content such as games, images, infographics, graphics, memes, podcasts, simulators, among others, in order to surprise the student in asynchronous moments or outside the classroom, to reduce apathy and generate meaningful learning.

This review did not focus on the medium to disseminate these contents. Despite this, some studies mentioned some environments such as Moodle, Classroom, web pages, blogs, role-playing games such as class craft, among others. Although it depends on the creativity and accessibility of each teacher, it would be worth exploring these new media and create content adapted to interactive platforms that have emerged in the implementation of quality virtual education.

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