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Flipped Classroom Technique in Higher Education: A Systematic Review

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Abstract

The purpose of this article was to identify the use of learning analysis within the classroom invested in recent years in order to reach an updated state of the matter. Therefore, a sequential explanatory design was developed, characterized by a first stage, in which qualitative data are collected and examined. To comply with the foregoing, a systematic review of the scientific literature is carried out. The review process took place between October and December 2020 and January 2021. It used four electronic databases: Scopus, Pro Quest, EBSCO Host and Google Scholar, and was developed in four phases. Thus, the review carried out has a detailed analysis in terms of quality, quantity and consistency of the research results, following the structure of recommended items for systematic reviews and metadata of PRISMA. In conclusion, it is recognized that master classes should not disappear, especially in qualifications that require it, but should be complemented by active teaching strategies that promote meaningful learning of knowledge. Beyond the simple technological incorporation in the classrooms of university institutions, the fundamental debate lies in finding a true methodological renewal and an educational transformation that allows us to live up to the circumstances of today's society. Thus, the FC is considered a dynamic, flexible and adaptable educational resource, which requires compliance with general guidelines.

Keywords: inverted classroom; university teaching; teaching method; education; learning.

INTRODUCTION

Over the years, education has been constantly evolving, optimizing theories, pedagogical models, procedures, tools and even concentrating technological tools. A clear example has been the flipped classroom technique. Which begins with the analysis of its American founders Jonathan Bergmann and Aaron Sams. Specialists who, when showing that due to different contexts the student found it difficult to attend classes; it emerged as an initiative to provide tutorial videos for students to visualize at home and in the next class work with tasks that allow reinforcing this theme. The flipped classroom is defined as a learning technique that aims for students to assume active roles to analyze various topics through videos, forums, dialogues, among others, in order to develop a meaningful learning procedure (Salazar, 2017). In this sense, this technique has promoted a leading role in learners, using technological instruments in order to facilitate teaching-learning processes, taking advantage of the time in the classroom to dispel fluctuations.

Therefore, the flipped classroom deploys learning procedures outside of classes through digital technology. Among its objectives is to improve the times allocated to face-to-face classes, given that students previously in their homes review their tasks and come to the classrooms to solve doubts and practice what they learned (Barral, Ardi and Simmons, 2018). In order to achieve optimal learning, the flipped classroom has integrated different digital applications, which contribute to students easily entering the data, managing them easily and processing them collaboratively to achieve useful and significant learning (Fernández, Muñoz and Delgado, 2018). Consolidating a virtual learning environment has originated the study of discernments, currently conceptualized as the processes of obtaining and interpreting various categories of information collected in student activity, with the purpose of analyzing their academic progress, improving their

performance and leveling inconveniences at the educational level.

Among its particularities is that it analyzes learning patterns, which arise from interactions with the user-student, qualitatively and quantitatively; it also has essential elements, such as the periods that students dedicate to virtual classes, a place in which they access virtual spaces and the peculiarities of groups or populations; it is also based on network study tools; among its methods of analysis, it has essential factors, such as the collection of data, the study of student information, the characterization and solution of the requirements or inconveniences of the student body and the study of the environment; seeking to optimize learning-teaching processes (Rojas, 2017).

Currently, university education procedures primarily need access to the Internet as a means of communication, where programming or virtual tools are educational and informative. In virtual classes, the student is given the commitment to examine the content of the class in their home, so they can solve any doubt and work on the definitions in the class individually (Bermeo and Zorrilla, 2019).

Based on the above mentioned in this study, the flipped classroom is understood as the technique that is proposed as a goal the innovation and investment of educational processes, which proposes in a first period learning from home, a process in which students must investigate and interact with the digital content provided by the teacher such as learning in virtual environments, podcast, video tutorial, among other activities, in order that when the student arrives at classes he can actively participate, practicing his knowledge and solving doubts and uneasiness.

In recent years systematic studies have been carried out with specialized references on the study of learning, however, care has only been taken in the analysis of the definition, its development, and the procedure carried out. However, no systematic reviews have been carried out that identify the most effective use and results of this technique to improve learning processes in students. From this perspective, the questions that arose in this study have been; What is the development of learning analysis within the flipped classroom in the last four years? and what were the results of using learning analysis within the flipped classroom as opposed to other methods?

Based on the above, this systematic review has as its main objective to identify the use of learning analysis within the flipped classroom in recent years in order to achieve an updated state of the art. For which a sequential explanatory design will be developed, which is characterized by a first phase, where qualitative data are collected. In order to comply with the above, a systematic review of scientific grammar will be carried out. This study methodology aims to integrate in an organized manner the results of empirical research on various topics of study. This review broadly extends as a study based on different levels of knowledge. The review processes were carried out between October and December 2020 and January 2021. In which four electronic databases were used; Scopus, Pro Quest, EBSCO Host and Google Scholar, which were developed in four phases.

METHODOLOGY

The systematic review of literature (RSL) is a complex procedure which equalizes, analyzes and deciphers all the important data in relation to a research question, thematic area or subject of interest (Kitchenham, 2004); which provides a starting point for the academic community and needs planning, search, selection and systematization. In this research, a systematic review of various scientific research has been carried out in order to identify and obtain more data on the experiences of application of the flipped classroom technique in the university environment in the last 4 years. In general, the systematic review involves a detailed and complete planning, in addition to previous search strategies, with the aim of reducing biases in the identification and evaluation, synthesizing all the most relevant research on the subject under study.

For the development of this systematic review the approach that was used part of the clear and concise formulation of the purpose of this study. Through this research, the use of systematic and reproducible techniques contributed to the identification, selection and critical evaluation of research with greater relevance. The collection of information from detected research was selected through the following keywords: flipped classroom, university teaching, flipped

classroom. The periods analyzed were from 2017 to 2021, which correspond to the consolidation of this methodology, in relation to the research reviewed. Study that contributes to the analysis of the flipped classroom technique in university education.

Consecutively, the search engines that will be used were delimited. As electronic databases it was decided to use: Google Scholar, EBSCO Host, Pro Quest and Scopus, under this panorama were obtained studies of the first three search engines. Of the 120 studies identified, 93 were rescued with open access in the different search engines already mentioned, among which 17 were chosen. Then to classify the data, a selection was considered through two steps. First, a previous exploration was carried out taking into account that the title and the abstract were made in a clear way according to the theme of the research. Next, an exhaustive collection of the texts was considered as its previous analysis.

In this sense, the review that was carried out for the thorough analysis in relation to the quality, amount and stability of the results of the study, based on a structure of items recommended in a systematic review and priSMA metadata. This method is used in the scientific community, which is considered one of the best sources to obtain data on a subject of study, because it offers a credible and complete analysis. The stages carried out in this systematic review have been the following:

Phase 1. Inclusion and exclusion criteria

As an inclusion criterion, it was evaluated; indexed journals published in the databases of Google Scholar, EBSCO Host, Pro Quest and Scopus between 2017 and 2020; Research that in its titles summaries or keywords was included the term flipped classroom, university education, flipped classroom; studies that have conducted empirical studies in the university context and research published in English or Spanish. While as an exclusion criterion was obtained: academic texts that have not been the result of empirical studies, in another context theses and abstracts of academic books were excluded, as well as other systematic reviews.

Phase 2. Search prowess

As search strategies, a couple of essential factors were considered: flipped classroom, university student. In the databases, the search was limited to abstract, titles, and keywords

Phase 3. Information debugging

A total of 120 articles were obtained in the two databases, 70 were duplicates, so that an initial review of 93 investigations was carried out in order to identify the relevance of all of them for the purposes of the study. Initial exploration in which 76 investigations were discarded for not presenting empirical data, for which 17 articles were subjected to review.

Phase 4. Data coding and analysis

Data analysis procedures were performed taking into account the following:

1. Amount of research that performed learning analyses in the flipped classroom.

1. Educational levels in which learning analyses were applied in the flipped classroom.

2. Areas of discernments in which it was applied in the study of learning in the flipped classroom.

3. Purposes of the application of the study of learning in the flipped classroom

4. Result obtained after the analysis of learning in the flipped classroom.

RESULTS

The prism diagram was elaborated to better understand the information, in order to improve the presentation of the systematic review, this tool is of great help for the critical assessment of the findings found, in the following diagram the investigations found by each academic search engine are shown, as well as the exclusion criteria for the development of the study are evidenced.

According to the established criteria, a total of 17 selected studies were obtained, as shown in the following figure

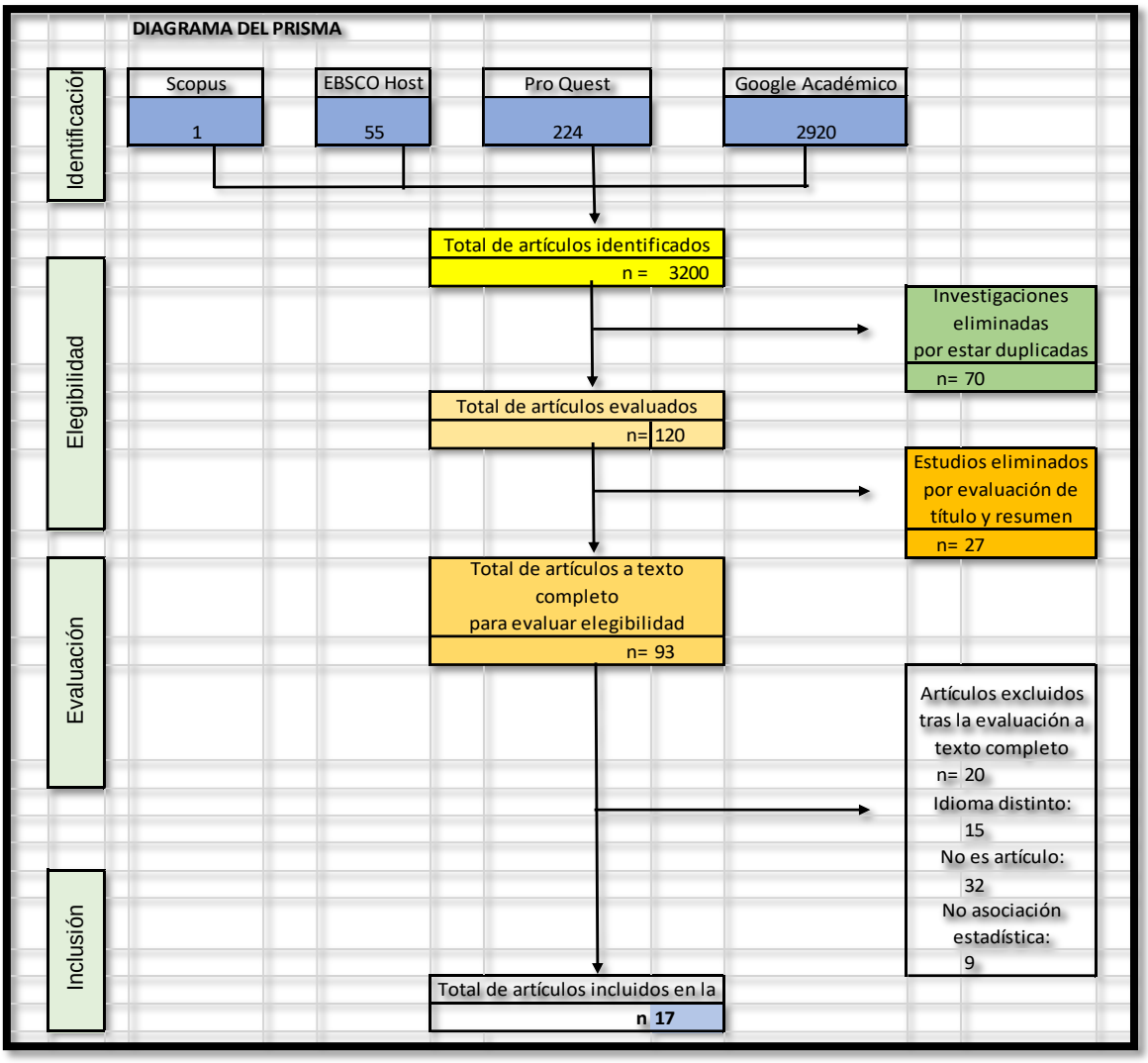

Figure 1. Prism diagram.

For the search for the information, the various logical operators were used; the same ones that facilitated the search for the information, to facilitate the application and is carried out in less time, the same that helps to obtain a greater number of selected citations, which improves the search for scientific information, accompanied by keywords, having the results in a general and advanced way. The information search was performed in four (4) databases, the same as shown in the following table:

Table 1. Database.

DATABASE SEARCH				
DATABASE	**SEARCH FORMULA**	**GENERAL**	**OUTPOST**	**%**
Pro Quest	TITLE ABS ("Flipped" OR " "aprendizaje invertido" OR “clase	300	224	37

	invertida" OR "aula invertida"			
Scopus	TITLE ABS KEY ("Flipped" "aprendizaje invertido" "clase invertida" "aula invertida AND "estudiantes universitarios"	1	0	1
EBSCO Host	TITLE ABS KEY ("Flipped" "aprendizaje invertido" "clase invertida" "aula invertida AND "estudiantes universitarios"	70	55	10
Google Académico	TITLE ABS ("Flipped" OR " "aprendizaje invertido" OR “clase invertida" OR "aula invertida"	3500	2920	60

In the database where the largest number of articles was found, at the level of advanced search related to the research topic, it is possible to appreciate that they belong to the EBSCO Host search engine, which will be useful for research, the same ones that are shown in the legend of the following image

Figure 2. Advanced level of database search.

Likewise, the following table is presented, which shows a list with the authors of the articles and their respective contribution to the research, so it was necessary to review the 17 articles from which fragments expressed by their authors were extracted and that are useful for research, since it will allow a more objective and precise theoretical framework.

Table 2. Database list.

Item	Article/source	Author	Contribution

01	Digital hypertexts as teaching material for the previous study on the flipped classroom methodology: perceptions of health scholars.	Bandaira, C. & Martins, C. (2020)	By developing classes invested in higher education, in the discipline of anatomy and developing materials for previous study in the form of digital hypertexts, the teacher can use devices such as sensitizing the class by the theme and awareness of the importance of this action for their good performance, in addition to clarifying how the methodology works.
02	Didactics of the flipped classroom and the teaching of physics at the Technical University of Ambato	Pérez, V. Jordán, E. & Salinas, L. (2020)	The flipped classroom strategy is a methodology used in the constructivist model since it is focused on the student and the development of their research capabilities based on the culture of learning and no longer teaching and on a permanent interaction between the facilitator (teacher) and student, both individual and group. Flipped learning becomes a starting point for planning classes and responding to the needs and expectations of twenty-first century students.
03	Rethinking Technical Higher Education: Implementing the Model flipped classroom as a possibility for new ways of learning	Laura, C. & Almanza, L. (2020)	The flipped classroom model proposes new pedagogical possibilities in the professional technical field in accordance with the educational reforms in Peru, that is, that education is more flexible, meaningful, with more proactive, responsible, autonomous, tolerant and critical students.
04	Initial teacher training: active scenarios from a flipped classroom perspective	Hernández, C. Prada, R. & Gamboa, A. (2020)	This work adds to the growing literature on the flipped classroom and encourages teachers and researchers to experience how this model can improve traditional courses, on the one hand using the FLIP principles, which act as a generic guide to change their classes and improve student performance and on the other, based on pedagogical principles related to constructivism, active learning and collaborative learning; cooperative learning and experiential learning associated with learning styles, to guide the design of interactive learning environments.
05	Education and new communicative methodologies: flipped classroom	Pozuelo, J. (2020)	The Flipped Classroom pedagogical model allows students to carry their own pace of learning, since it allows them to listen, pause and repeat the explanations as many times as they need it. The fact that they are content videos created by the

			teacher creates a positive link between the teacher and the student.
06	Student-centered knowledge study through flipped learning	Conde, S. e Igarza, S. (2020)	Applying the inverted learning method means reversing this whole process, the use of the tools that facilitate the different themes of programming languages. Students access some of the contents of the subject, outside the classroom, usually through videos that are uploaded in the virtual classroom of the university. These resources allow the student to establish a first contact with the contents or tools to be worked on.
07	Perception of the flipped classroom strategy in university scenarios	Gaviria, D. Arango, J. Valencia, A. Bran, L. (2020)	As evidenced in the study, participants in general reacted positively to mediation in the development of the course with educational videos, through which they could prepare for face-to-face sessions not only with reading materials.
08	Perception of university students regarding the pedagogical model of inverted class	Sánchez-Rivas, E., Sánchez-Rodríguez, J., & Ruiz-Palmero, J. (2019)	In general, the contribution of this research to the scientific community is concretized in a better knowledge of the student's perception of the inverted class model. In this sense, it has been analyzed that, from the perspective of the student, the pedagogical model of inverted class presents advantages for their training process.
09	Impact of the flipped classroom during the educational process superior over derivatives considering data science and machine learning	Salas, R. & Lugo, J. (2019)	The Flipped classroom model promotes the effective organization of school work by facilitating the monitoring of tasks and the resolution of doubts in the classroom and encouraging the autonomous work of the student
10	Flipped classroom in higher education. A study through student stories	García, D. & Cremades, R. (2019)	The study shows that the flipped classroom has been perceived as an innovative, useful and close resource, increasing most of them cooperative learning, socialization and autonomy, as they also pointed out in another educational context.
11	Classroom Experience invested to promote prosumer students of the higher level	González, M. & Huerta, P. (2019)	The pedagogical design of this technique was able to demonstrate the constructivist support from the perception of the student, because by placing him as a producer of his knowledge and content, he assumed an active role, by consulting, solving and producing educational products.

12	Structural model of extrinsic factors influencing flipped learning.	Mengual, A. López, J. Fuentes, A. & Pozo, S. (2020)	One of the methodological approaches that is emerging as a result of educational innovation is the flipped classroom. This model of teaching and learning is based on the idea that students can visualize and work on the contents of the next face-to-face sessions in the classroom outside the academic environment, in order to devote as much time as possible in class to problem solving and the deployment of a more practical work, participatory and active.
13	Flipped classroom with emerging technologies in virtual environments at the University Salesian Polytechnic of Ecuador	Rivera, F. & García, A. (2018)	In the flipped classroom, assertive communication and timely feedback must prevail, since it contemplates the activity in class and direct orientation, first with peers in collaborative work and second with the teacher as a guide in class, to bring to the application the concepts that previously the students have worked on.
14	A proposal for a flipped classroom in the subject of signals and systems of the National University of Colombia	Reyes, A; Cañón, M. Olarte, F. (2018)	Most students who participated in this implementation process considered the flipped classroom methodology as a strategy that made it easier for them to understand the theoretical elements and practical applications of the concept of convolution. As part of the results generated in this experience, it was evidenced that the educational resources proposed to be approached autonomously by students can become a determining factor in the implementation of the flipped classroom strategy.
15	The interactive and independent work of students in their French language training on the basis of "flipped classroom" technology.	Kuzmina, E. Nazarova, G. Nizamieva, L. & Leblanc, C. (2018)	The implementation of the Flipped Classroom strategy in the teaching of foreign languages meets the objectives of strengthening the practical orientation of modern education. At the same time, not only the result of the training, but the process itself acquires a capital importance; that is, the ways and means of achieving this result, chosen by the fellows, determining the future development of a university. Graduated, as an enterprising and creative-minded professional.
16	Flipped classroom mediated by the use of virtual platforms: a study of case in the training of physics teachers	Hernández, C. & Tecpan, S. (2017)	The results obtained provide evidence to continue using this pedagogical model in initial teacher training, as it allowed them to reflect on the students, they will encounter in their professional lives who are distinguished by being habitually

			connected. This facilitates access to different learning content that if properly managed by the teacher contribute to the deep and reflective learning that the knowledge society demands.
17	Flipped classroom pilot experience to improve the teaching-learning in the subject of Thermodynamics Technique	Begoña, I.; Usón, S. Llera, E. & Martínez, A. (2017)	The main demand of students to improve the learning process is to increase the time spent by the teacher to problem solving during face-to-face classes. The flipped classroom model has been able to contribute to the significant increase in the percentage of students who have passed the subject in the first call.

DISCUSSION

Through the documentary analysis of the empirical studies, various results were found on the implementation of the flipped classroom. Essentially highlighting the motivation and active cooperation of the students in the course of the classes and consequently improvements in academic performance are evident. Thus, favoring the learning processes of students, as well as the complacency of teachers and academic authorities (Hernández and Tecpan, 2017). Therefore, students show commitments, interest and acquire modern skills, through pleasant and fun actions (Gaviria, et al, 2020). Elements that have promoted spaces for dialogue, debates, questions and studies, before during and after academic activities. In this sense, teachers are facilitated to plan activities that contribute to promoting interactions and cooperation with the student.

Likewise, these models of inverted learning not only increase the motivation of students, on the contrary, they decrease the percentages of university dropout (Pozuelo, 2020). In this sense, students develop skills such as self-learning, curiosities reinforce their levels of confidence, have knowledge about the subject of study and dispel doubts and concerns with teachers. The flipped classroom technique transforms academic procedures, planning activities in advance at home, this being beneficial. Since, through this tool, the student takes advantage of and improves the time invested in classes for the resolution of their practical, empirical activities, as well as those that require feedback (Salas and Lugo, 2019). In this way, students not only favor their learning techniques, but also teachers improve their teaching skills. In another sense, some studies highlight the correlation of this technique with ICT tools, either for autonomous or collaborative activities. Evidencing positive solutions in students, given that they remain active and dynamic, due to the interactive learning environment (Laura and Almanza, 2020). However, if those involved in the educational process do not have these technological resources, it becomes a limitation for educational processes.

CONCLUSIONS

The processes of teaching and learning involve different contexts that transform it into a complicated and hard-working act. Consequently, the flipped classroom technique used as a didactic method is an important instrument in the educational and ICT context. Its implication contributes to the increase of the commitments of the students in the formative process, to act proactively, contracting a more critical, cooperative and reflective behavior. Another of the conclusions of the study is that the flipped classroom technique in its flipped classroom version, is understood as a method conducive to the transformation of traditional teaching processes to interactive and dynamic learning processes, in which the use of technologies that allow the attention of students through dynamic activities that promote effective learning for students is helped.

In another sense, it should be noted that various proposals, suggestions, expertise and theoretical compendiums on the flipped classroom coexist

in the studies collected that give a contribution to this research. However, a large number of articles stand out in the English language area, because in this chair various problems are evidenced that guide the exploration of new methods that contribute to the use of time in the classroom in practical and communicative activities; being important to encourage students to be the protagonists of the learning processes. As is to be recognized, the classes taught by teachers should not vanish, especially in required chairs, however, they must be complemented with active skills of meaningful learning. After technological incorporations in university halls, the main theme arises from finding an essential transformation of procedures and educational changes, which contribute to improving the educational processes of today's society. Therefore, the FC is considered a didactic and dynamic tool, with flexibility and adaptation, which needs to comply with regulations generally. Finally, it should be noted that the flipped classroom technique is consolidated as an effective resource that contributes to the progress of general skills, improving lifelong learning and preparations for professional markets. Therefore, it is to be concluded that both students and teachers show a satisfactory result, which depends on their commitments to obtain favorable results.

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