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Flipped classroom and cooperative learning in postgraduate studies: an experience at the University of Informatics Sciences

Clase invertida y aprendizaje cooperativo en postgrado: experiencia en la Universidad de las Ciencias Informáticas

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Summary

The objective of this article is to analyze the effectiveness of the Flipped Classroom and cooperative learning as didactic strategies in a subject of the postgraduate course: The classroom in the contemporary university. The research was developed at the University of Informatics Sciences (Cuba). The methods used were historical-logical, synthetic analytical, inductive-deductive, participant observation, a student questionnaire, percentage analysis and Iadov's technique. The results obtained show that the Flipped Classroom approach and cooperative learning are effective for the achievement of learning and the development of skills in students. It is concluded that it gives an active role to students in the construction of their learning and reassigns a role of mediator to the postgraduate teacher. The students have a satisfactory assessment of the experience.
Keywords: cooperative learning, flipped classroom, postgraduate studies

Resumen

El objetivo de este artículo es analizar la efectividad de la Clase Invertida y el y aprendizaje cooperativo como estrategias didácticas en un tema del curso de postgrado: La clase en la universidad contemporánea. La investigación se desarrolló en la Universidad de las Ciencias Informáticas (Cuba). Se utilizaron como métodos el histórico–lógico, el analítico sintético, el inductivo–deductivo, la observación participante, un cuestionario a estudiantes, el análisis porcentual y la técnica de Iadov. Los resultados obtenidos muestran que el enfoque de la Clase Invertida y el aprendizaje cooperativo son efectivos para el logro de aprendizajes y el desarrollo de competencias en los estudiantes. Se concluye que da un rol activo a los estudiantes en la construcción de su aprendizaje y reasigna un rol de mediador al docente de posgrado. Los estudiantes tienen una valoración satisfactoria sobre la experiencia.

Palabras clave: aprendizaje cooperativo, clase invertida, postgrado

Introduction

Classroom quality is vital to achieve an excellent teaching-learning process. Most of the professors at the University of Informatics Sciences are graduates in Computer Science Engineering. This aspect constitutes a strength from the point of view of the mastery of the disciplines of the career, but the graduates have not been trained as teachers and need training as university professors.

Graduate students require a more participatory, active and responsible attitude in their learning process for the better development of social, technological and labor competencies [1] [2]. In the flipped classroom, student participation is encouraged, in an autonomous way, in previous activities designed by the teacher, who previously performs passive learning activities outside the classroom. The classroom space is reserved for active learning activities [3]. The model has been validated in the areas of health education, exact sciences and second language acquisition, and uses digital resources that are spread online [4] [2] [2].

The flipped classroom is an educational innovation that provides good results. Among the most recognized are the motivation of students, as well as a greater participation of students in classroom activities, becoming active agents and responsible for their learning. It contributes to strengthening communication between teachers and students [5] [1], to the achievement of cognitive and affective objectives, and significant improvements in knowledge [6] [7] [2].

As positive aspects of its application, it is recognized that, unlike traditional education, it gives the student an active role, autonomous, responsible for their learning and able to organize and manage their time to achieve the objectives set [8] [2] [2]. It favors the acquisition of knowledge in a practical way and increases academic performance and promotes the development of key competencies in the educational process such as organizational skills, autonomy and responsibility [2].

It promotes cooperative learning and more successful interpersonal relationships [5] [8]. It offers better success rates and better retention [9]. It is relevant or useful due to the large amount of information that must be dealt with in the context of a postgraduate course. Active role to students in the construction of their learning and guiding or mediating role to the expert postgraduate teacher [10] [4]. Their role in improving student learning [11] [2].

A high level of student and teacher satisfaction with its application is observed [12] [13] [13] [14] [11] [8] [6] [6] [3]. Several authors recognize the feasibility of implementing flipped classroom teaching in higher education and at the graduate level [15] [14] [14] [13] [11] [6] [4] [4] [2].

Among the requirements for the successful implementation of this approach are the need for personalization, self-direction, student-centered learning, repeated application, remediation [16], promoting engagement, metacognition, attitude, performance, understanding and achievement of students [17], obtaining sufficient practice by students, teacher supervision and feedback [11]. The teacher's facilitation role and continuous support for the successful implementation of this strategy [18], recognizing the relationships between knowledge, skills, student engagement and satisfaction [19], and collaboration [5] [16].

For the passive learning stage, autonomous session or knowing and understanding information stage, some support resources are employed through technology [13] [10] [10] [2] [2] [1]. Among these resources are videos from the Internet or created by the teacher, PowerPoint presentations, audios, articles, infographics, among others, delivered through platforms such as Moodle, virtual classrooms or other online channels.

These resources must be accompanied by an activity that guarantees their execution, such as: guides, questions, elaboration of graphic organizers, summaries or others [2].

During the classroom session, space is given to active learning, where students analyze, apply, evaluate and even create. They execute higher level cognitive processes considered in Bloom's taxonomy [20]. In this session, the teacher must work on active learning, as well as the development of students' critical and creative thinking, using methodologies based on team learning, problem-solving tasks and case studies [21] [4] [4] [1]. This allows the role of the teacher to be reconceptualized as a mediator or guide, and not only as an exhibitor [22] [8].

After the face-to-face session, post-class activities can be derived where the student maintains his active role, transfers and applies the knowledge achieved [23] [8] [8] [4].

The inverted classroom model, based on Vygotsky's Cultural Historical Approach, provides greater protagonism to the students and offers spaces for interaction through educational strategies supported by ICT. The learning strategies are centered on the student, and this learning is carried out through a cooperative activity, based on interaction with peers and teachers [24] [8].

One of the active methodologies used in the flipped classroom is cooperative learning. The implementation of cooperative learning in higher education emerges as a collaborative and active paradigm (focused on learning), which allows valuing students' previous knowledge and promotes a social type of learning [25] [8].

There are many definitions of cooperative learning, but it could be briefly defined as small groups where students work together to maximize their own and each other's learning through common goals, depending on each other to achieve them [26] [4]. When individuals cooperate, they work together to achieve shared goals and there is a mutual responsibility to work toward one's own success. Cooperative learning is generally contrasted with competitive and individualistic learning [27].

There is general consensus on five essential elements of any cooperative learning structure. The first element of cooperative learning is positive team interdependence. The second is individual and group responsibility. The third is stimulating interaction, preferably face-to-face. The fourth is to teach students some essential interpersonal and group practices. Finally, group evaluation is an essential component for the learning process to improve in a sustained manner. Members need to carefully analyze how they are working together and how they can increase the effectiveness of the group [26]. Cooperative learning is considered a methodological tool that can help solve the needs of 21st century students [27].

The objective of this article is to analyze the effectiveness of the Inverted Classroom and cooperative learning as didactic strategies in a topic of the graduate course: The classroom in the contemporary university. The research was developed at the University of Informatics Sciences (Cuba).

Material and method

The experience was developed in the postgraduate course: The classroom in the contemporary university. Twenty-one professors from the University of Informatics Sciences participated. The course was given from November 2021 to January 2022. Period in which all the professors were already incorporated to the university.

The following methods were used in this research: historical-logical, synthetic analytical, inductive-deductive, participant observation, a student questionnaire, percentage analysis and the Iadov´s technique to know the level of satisfaction of the participants.

Design and execution of the inverted classroom

The learning objectives that were intended to be achieved through this experience are those of Topic II: The categories of didactics and their relationships in a quality university class: objective, content, methods, means, organizational forms and evaluation. The teacher, the student and the group. The learning result that students were expected to achieve was: To argue the didactic relationships between objective, content, methods, means, organizational

forms, evaluation, the teacher, the student and the group according to the theoretical and methodological references studied.

In relation to the didactic sequence, and considering the context, participants and learning objectives, the stages or sessions of the inverted class proposed in the study by Mok (2014) [3] were considered: pre-class, class and post-class. Each stage considered learning resources relevant to the content, context and participants.

Pre-class or autonomous session

It was carried out prior to the face-to-face class. In the previous class, it was explained to the participants what the inverted class is, its stages and cooperative work. The reasons for its execution were argued. The classroom was divided into teams of three members and they were assigned: team 1 objective, team 2 content, team 3 methods, team 4 means, team 5 organizational forms, team 6 evaluation and team 7 teacher, student and group. It was oriented that all students would approach the categories of the teaching-learning process and, by teams, they would deepen in the theoretical positions of different authors they are expected to analyze.

It is important that students are aware of the methodologies that are implemented to facilitate awareness of their own learning processes (metacognition) and to learn by themselves and with others. These are tools that they can implement in their classes. The oriented materials and the tasks to be carried out were analyzed. Subsequently, the digital material was sent online to carry out the autonomous session. The resources had instructions and an associated activity to solve individually, in order to manage the new knowledge and take it to the face-to-face session. The resources sent were the following:

PowerPoint presentation with audio narration: The resource was developed by the teachers of the course. It included information selected from sources such as articles, books and regulations related to the contents of the topic. The PowerPoint incorporated audio. The resource also contained guidelines for developing a graphic organizer to visually manage the information given [4].

Didactics textbooks: Five Didactics textbooks published from 1996 to the present were selected. The students were divided into teams of three members. In addition, a guide with text analysis questions was sent. Table 1 details the resources sent and the associated individual learning activity.

Table 1. Digital resources used in the pre-class or self-contained session.

Resource	Description	Learning Activity
Power Point with audio narration.	Components of the teaching-learning process. Definitions and relationships. Theoretical positions Relationship among the process components	Written instructions and oral audio explanation to develop a visual manager that organizes and links the main contents reviewed. Among the options: 1. Prepare a conceptual map of the components of the teaching-learning process. 2. Prepare infographics with their definitions and relationships. 3. Answer to the questionnaire.
Didactics textbooks (Chapters dedicated to the Didactics categories)	Álvarez de Zayas, C.M. (1996). The school in life: Didactics pdf. CREA Authors Collective, (2003) Comprehensive Pedagogical Preparation for University Professors pdf. Addine, F. and others (2004) Didactics. Theory and Practice Castellanos S. D. et al. (2004) pdf. The developing teaching- learning process pdf. Páez, V. et al. (2017) The Didactics of Higher Education and professional training facing challenges of the 21rst century pdf.	Question guide. Analyze the components of the PEA. Different forms of graphic representation (Activity for all). Make a historical-logical summary of the evolution of the definition of the didactic category your team was assigned. Elaborate a systematization table. Elaborate an infographic with definitions and authors. Their relationships with the rest of the categories. Compare theoretical positions (in the aspect that your team had to work on). Assume a theoretical position and argue.

Class or face-to-face session (First face-to-face meeting)

To this session the students brought the materials prepared: graphic organizer, guide with solved questions. The session was carried out during two class blocks, in the first block the stages described below were executed.

- Introduction and clarifying questions: Previous knowledge from the previous class was activated through questions. Students asked questions in relation to the information analyzed in the autonomous or pre-class session. The answers to these questions were generated by the classmates themselves, and ultimately mediated by the teacher when necessary. Individual compliance with the activities of the pre-class or autonomous session was monitored. This part of the session lasted 15 minutes.

- Orientations for the cooperative learning activity: students were asked to organize themselves in teams of three members, oriented before the pre-class. They were asked to have on hand the materials they developed during the autonomous session. Each group received an envelope with three cards, each with a question, oriented to: 1) socialize the materials elaborated in the pre-class individually, b) critically analyze the information and c) elaborate a proposal on the basis of the acquired knowledge [4], starting from the assumed theoretical foundation and exemplifying the didactic category they had to address within a class fulfilling all its requirements. Finally, the duration of the group activity was indicated. This step lasted 5 minutes.

-Execution of the cooperative learning activity: The questions given were analyzed, socialized in the team and answered in the allotted time. During the course, teacher monitored and mediated on a rotating basis in each of the cooperative work teams [22]. Doubts were clarified and some dialogues were refocused as requested. This interaction is transcendental, since it allows for feedback among peers, comparison of appreciations on the content, socialization of strategies used for knowledge management and raising concerns. Duration 60 minutes [27] [24] [24] [23] [23] [21] [4] [1].

- Closing: Students were asked to answer questions to close the experience, aimed at: a) synthesizing what they had learned, b) clarifying any lingering doubts, and c) transferring what they had learned to reality. The teaching role was that of mediator while the participants shared their answers orally [4]. Student participation is evaluated. It is oriented that the socialization of the cooperative work is done in the next class session. Duration 10 minutes.

Second face-to-face meeting

- Introduction and clarifying questions: Previous knowledge from the previous class was activated through questions. Doubts were clarified. Duration 10 minutes.

- Socialization of the cooperative work: The work teams socialized the answers constructed from the analysis and discussion. The exposing team asks questions to the members of the other teams, or the remaining teams ask questions, comments or contributions to the exposing team. This space opens up learning in teams without limiting it to the working group, but rather contrasts and complements learning based on the criticisms and proposals of the other teams. Evaluation, co-evaluation and self-evaluation of the objective are carried out [4]. Duration 60 minutes.

Closing: Students were asked to answer questions to close the experience, aimed at: a) synthesizing what they had learned, b) clarifying any lingering doubts, and c) transferring what they had learned to reality. The teaching role was that of mediator while the participants shared their answers orally [28] [8] [4] [2]. The knowledge acquired is oriented to be applied to the lesson planning of the subject they teach [23] [4]. Duration 10 minutes.

The evaluation of the experience was carried out from the beginning, the teacher quantified the fulfillment of the activities oriented in the pre-class or autonomous session, during the process and at the end of the activities. The autonomous session or pre-class, classroom session or class, cooperative learning, achievement of learning outcomes and the level of satisfaction were evaluated with a student questionnaire. The participants made known, in writing, their strengths and weaknesses in each of these elements. For the level of satisfaction, the Iadov´s technique was applied. This technique constitutes an indirect way to study satisfaction [29].

Results and discussion

Regarding the fulfillment of the guided activities in the pre-class or autonomous session, it was found that 19 students went to the class or face-to-face session with the two guided activities completed for 90%, one with one activity not completed and another with two activities not completed for 5% respectively. The level of responsibility of the students in the fulfillment of the oriented activities is confirmed [1] [2] [5] [13] [28].

In the result of the questionnaire applied to the students to evaluate the sessions of the inverted class developed, it was found that:

Autonomous or pre-class session, the students manifest as strengths that the assigned activities were carried out. The digital resources were studied and the linked learning activities were carried out in the time managed in a personal way [2] [4] [28], the usefulness of the presentation with audio for the study. Some pointed out, as weaknesses, that they did not possess a complete mastery of the content delivered through the pdf texts. They pointed out the time needed to study the materials, that there were many texts to analyze, and suggested using other tools for video [9] [12] [18].

In the face-to-face session, all the participants pointed out as a strength that they showed critical and reflective analysis postures. They also stated that they were able to generate contextualized and transferable answers to the work reality [4] [6] [7].

In the cooperative work, all the students pointed out as strengths that there was a proactive attitude in learning, evidenced in the discussion, analysis, proposals and recording of the answers requested [2] [4].

Likewise, they indicated that they showed interest and good disposition towards the activities and an adequate climate [6] [7]. The students also indicated that feedback was generated within the team, collaboration [5] [28] for the improvement of the work. They emphasized responsibility, respect [4] [6] [6] [7] and the commitment of the members to enhance learning [9] [28]. The continuous support of the teacher [2]. Although, on the other hand, they stated as weaknesses that time management and organization are aspects that can be improved [4] [28].

Results socialization session: They pointed out as strengths that they were able to synthesize the learning and clarified the doubts they still had. Individual and collective responsibility, they highlight the attention received by the teacher [2] [4]. The adequate exposure of the teams and the good results in the evaluation [2] [6] [6] [7] [7] [11] [28]. As weaknesses, they referred to the fact that the teams should adjust to the established time (two teams did not adjust).

Learning results, on the objective: To argue the didactic relationships between objective, content, methods, means, organizational forms, evaluation, the teacher, the student and the group according to the oriented methodological theoretical references, the students indicated that they recognize and differentiate the didactic categories and identify their relationships. They pointed out as strengths that they manage to have a critical and analytical posture on the theoretical referents analyzed. They value that the content addressed is useful for their professional work and can be transferred to the educational reality [4] [7] [28]. They indicated that they approved the evaluative activities satisfactorily [2] [6] [7]. However, they stated as a weakness that some of them still show difficulties in applying the content to their teaching planning. Table 2 shows the results of the Iadov´s technique. Number of teachers (N = 21)

Table 2. Results of Iadov's technique

Clear Satisfaction	More satisfied than dissatisfied	Not defined	More dissatisfied than satisfied	Clear Dissatisfaction
19	1	1	0	0

A group satisfaction index was calculated: $\text{ISN} = \frac{1\ (+1)+1(+0.5)+1(0)+0(-0.5)+0(-1)}{2} + \frac{1\ .5}{2} = 0.92$

The result was (0.92) which demonstrates the high degree of satisfaction declared by the professors upon receiving the subject of the graduate course. The open questions (3 and 6 of the survey) made it possible to delve deeper into the nature of the causes that led to the different levels of satisfaction. The aspects that the participants liked the most were: the use of PowerPoint with audio. They point out that it is very beneficial because they can watch the presentation it as many times as they need to understand the content and at any time they choose [1], the use of visual managers: concept maps, infographics for the organization of the content, better understanding of the subject, knowledge of conceptual and methodological tools for collective and critical reflection on their own practice, the possibility of learning by themselves and with others, of applying the knowledge acquired to their professional practice, collaborative work [3] [16] [19] [6] [18] [15] [15] [17] [28].

Time management and organization, the incorporation of videos where the teacher can be observed explaining, and the incorporation of playful activities are pointed out as aspects to be improved.

Conclusions

Taking into account previous works from other institutions, even from other countries, enriched and improved the intervention, in aspects such as the visual managers used for the presentation of the materials and the didactic strategies implemented. It is relevant or useful due to the large amount of information that must be dealt with.

These results show the benefits of using the flipped classroom and cooperative learning by giving an active role to graduate students in the construction of their learning and reassigning a mediating role to the graduate teacher. The students have a positive and satisfactory evaluation of the experience; the acquisition of knowledge, responsibility and commitment are recognized as achievements with its application.

However, there are elements that are important to continue working on, such as the diversification of applications for the design and development of videos, the identification of other ludic strategies for classroom activities, as well as the creation of more evaluation instruments that allow us to observe the appropriation of didactic categories and their relationships.

It would be interesting and pertinent to examine the difficulties and possibilities of carrying out a fully online flipped learning in the graduate program.

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Contribución de autoría

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Conflicto de intereses

Todos los autores del artículo declaramos que estamos de total acuerdo con lo escrito en este informe y aprobamos la versión final.

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