# Chapter 1
# Active Peer-Based Flip Teaching: An Active Methodology Based on RT-CICLO

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## ABSTRACT

*The RT-CICLO model (real time – collective intelligence applied to a cooperative learning with a social base) is based on generalist processes identified in main active methodologies. This model has been developed as a general model. Therefore, it could be applicable to any active methodology. The main characteristic of the RT-CICLO method is not only to foster active learning, but also to enable students to acquire active skills. In this chapter, the RT-CICLO model is applied to a flip teaching methodology throughout all its phases (lesson at home and homework in the classroom). The main results are obtained in two steps. The first step confirms that students acquire active skills. The second one explores the impact of knowledge creation by students as a way to get feedback and to use the created knowledge as a learning object. It should be highlighted that students' perceptions are positive using this approach.*

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## INTRODUCTION

The Flip Teaching (FT) method, also known as Flipped Classroom, is mainly characterized by the reversal of the training model. In a traditional model, the lesson is taught in the classroom and homework is done at home. However, in the FT method the student takes lesson at home and does homework in the classroom (Bergmann & Sams, 2012). Therefore, the place where the learning process takes place is the real change, because the methodology does not really change. But why has a simple change of place in the implementation of learning activities had such an impact?

The answer may be that the real change is connected with the students' inactivity (or their activity). They usually remain inactive during the teaching of a masterclass. That is, their actions are almost limited to listening, one of the activities with the least impact on learning (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). Nevertheless, homework involves cognitive activities that positively influence learning (relating knowledge, reflecting, making decisions, creating knowledge, etc.).

Thus, in the traditional model, students remain passive in the classroom, precisely when they are with their peers and teaching staff. However, when students are on their own at home, they perform many more cognitive activities that contribute to their learning. Conversely, in the FT method, the students' inactivity moves from the classroom to their homes, where they watch the lessons previously recorded in video format. In this way, students, who are more active in the classroom, can carry out this activity cooperatively by matching teachers and students. Consequently, if there is timing, people generate knowledge as long as there is interaction and active participation (Clare Newton & Ruiz Carrillo de Albornoz, 2015).

However, this situation evinces a significant obstacle in terms of FT implementation. Traditionally, it is based on the premise that students attend a class having learnt their lessons at home (Baker, 2000; Lage, Platt, & Treglia, 2000), and they are actively engaged in the classroom with their acquired knowledge (Strayer, 2012). Therefore, students should also be active during the lesson at home to increase their learning from a quantitative and qualitative point of view. It seems then that applying active methodologies during the lesson at home would be the most appropriate technique.

Students' active participation implies more efficient learning, since more cognitive actions are involved (Dewey, 1916, 1929). Methodologies for promoting greater students' involvement throughout their learning process are called 'active methodologies'. In this respect, many research studies clearly indicate that FT method corresponds to an active methodology (Khailova, 2017; Lambach, Kärger, & Goerres, 2016; Smallhorn, 2017).

In addition, active methodologies entail getting students' reflections from an action: individual and cooperative knowledge created from the existing one (Bringuier, 1977) and feedback from the created knowledge (Chickering & Gamson, 1987), through social interaction (Vygotsky, 1978) and their interaction with the environment (Fitzgerald & Ausbel, 1963).On the basis of these characteristics, the authors of this paper have previously presented a variant of the FT model. The so-called Micro Flip Teaching (MFT) consists of complementing the lesson at home (the teacher's video) with an activity that the student must perform before attending the class (Fidalgo-Blanco, Martinez-Nuñez, Borrás-Gene, & Sanchez-Medina, 2017).

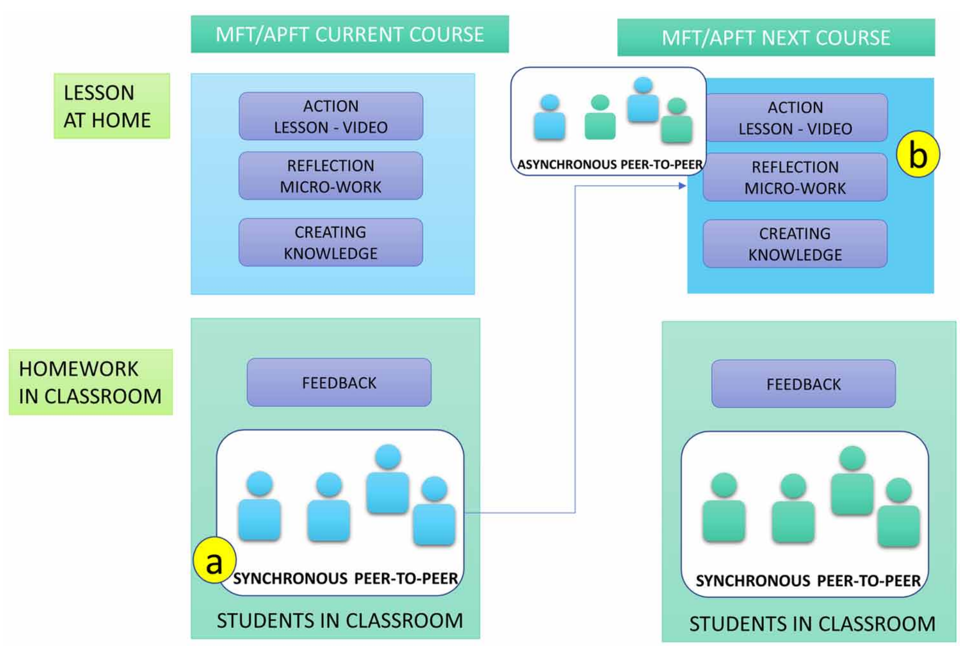
In the MFT method, after viewing a video, students make a reflection about the lesson at home. The accomplishment of an individual task (Fidalgo-Blanco, Martinez-Nuñez, Borrás-Gene et al., 2017), a cooperative micro-task (García-Peñalvo, Fidalgo-Blanco, Sein-Echaluce, & Conde, 2016) or a cooperative mini-challenge (Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2016) should reflect the aforementioned students' reflection. This approach allows a student or a group of students to create contents during the lesson at home. In addition, teachers use these contents as evidence of acquired learning and to provide cooperative feedback during the activity in the classroom. MFT not only permits students to be active both outside and inside the classroom (Sein-Echaluce, Fidalgo-Blanco, & García-Peñalvo, 2015b), but also to create an additional effect −the knowledge create by students, either individually or cooperatively (Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2018). This kind of generated knowledge is not only useful as teacher's feedback during the learning process, but it can also serve as a learning object in the current course, as well as in other classes, courses and the like.

The situation outlined above allows us to carry out two types of peer-to-peer learning. The first one is produced from the teachers' feedback making during homework in the classroom as a result of the knowledge created by the students of the subject. This type could be called 'synchronous'. The second type - 'asynchronous' - takes place during the lesson at home using the knowledge created by students in previous courses and subjects. Figure 1 shows both types of peer-to-peer learning. Figure 1-a represents 'synchronous' peer-to-peer learning, and Figure 1-b the 'asynchronous' type.

The new innovation to the MFT method was introduced by the authors of the present study with the name Active Peer-Based Flip Teaching (APFT) (Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2017).

Previous studies have shown that APFT is a valid method for asynchronous peer-to-peer learning (Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2017; García-Peñalvo et al., 2016). The aim of this case study is to demonstrate that the APFT model, other than being an active learning method, also favours students' acquisition of active habits. In order to achieve this goal, this model will be applied in a total of 19 work teams in a freshman course at the Polytechnic University of Madrid. In addition, this study presents a generalist model to apply active learning methods. This model is applied to the APFT method and the students' perception of the effectiveness of this new model is measured.

*Figure 1. Synchronous and asynchronous peer-to-peer in a Flip Teaching model*



## PROPOSED MODEL

On the one hand, there is no single method for active learning, but rather a variety of methods exist and coexist such as problem-based learning, service-learning or challenge-based learning. On the other hand, there is no common model, either, to be applied to all methods.

Active methodologies have been defined by several relevant authors and taken as a reference worldwide in relation to active learning (Piaget, 1964; Kolb, 1984; Vygosky, 1978; Bloom et al., 1956; Ausubel, 1969, among others). In this study, the integration of the different characteristics associated with the aforementioned active methodologies is proposed.

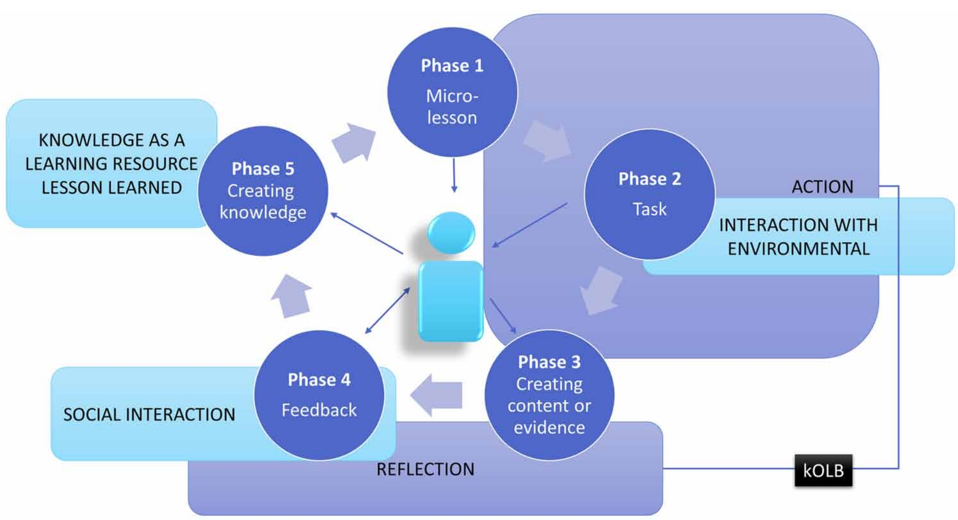
### Model Phases

Figure 2 shows a common model to any active methodology: face-to-face, online or mixed systems (blended learning). The model is called RT-CICLO (Real Time – Collective Intelligence applied to a Cooperative Learning with a sOcial base). This model comprises five phases described in more detail below.

**Phase 1:** The first phase consists of a micro-lesson (figure 2-1). The duration of the micro-lesson should not be longer than 10 minutes, in order to maintain the students' attention (Medina, 2008). The purpose of this micro-lesson is to provide the conceptual basis. In this way, students can start to perform a specific action autonomously.

**Phase 2:** The second phase contains a task (figure 2-2) that consists of a micro-work ―which can become part of broader work― or a challenge― that is individual. The aim of this phase is to encourage students to apply the knowledge acquired with the micro-lesson on an individual or a cooperative way. Getting online accessible evidence from the task is desirable. Task-based content should involve student interaction with the environment, which favors active learning (Ausubel, 1969).

*Figure 2. The RT-CICLO model*



The environment can be either the subject itself or a context related to it. As for example, tasks involving companies related to the subject contents or competences.

**Phase 3:** Evidence left by the task constitute the third phase—i.e. they are based on the resources created by students individually or cooperatively. (figure 2-3). Content creation involves the application of high-level cognitive abilities (Bloom et al., 1956). The evidence can be the task result itself or the steps taken throughout the process. However, in both cases, the evidence should fulfil the following characteristics: having a digital format, being transferable, being stored in an on-line device, being accessible by the teachers and being shared with the remaining students.

**Phase 4:** The feedback (figure 2-4) is cooperative and it is assessed involving the rest of the students. Feedback occurs when the teacher uses the content created in phase 3 by students (Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2019). It should be used as a learning object in real time and throughout the course. Teachers perform both positive and negative feedback. Positive feedback is made from a correct task result while negative feedback comes from an incorrect result. In any case, the objective is to reinforce learning.

Face-to-face and/or online feedback carried out with the involvement of all students generates social interaction between them, which benefits active learning (Vygotsky, 1978). Social interaction can be complemented with a social network in order to register both student-student and student-teacher interactions (Sein-Echaluce, Fidalgo-Blanco, Esteban-Escaño, & García-Peñalvo, 2017).

Peer-to-peer learning takes place in this phase from the contents created by the students themselves. These resources are used in a synchronous way since the action is carried outside the classroom.

The four phases set above is considered as the action-reflection principle. Through an action —phases 1 and 2— students create a content —phase 3—, and later, they collectively reflect on the content created —phase 4—. The action-reflection principle is considered as an active learning enhancer (Kolb, 1984).

**Phase 5:** In this phase (figure 2-5), from the feedback received in phase 4, students rework on the contents created in phase 3. Apart from correcting the result —in case it needs correcting— a commentary about why the result was not right, as well as the changes made to carry out the correction, should be added. Although the content is right, the reason why it is right should also be justified. In this way, the learning experience can be incorporated into the created content.

Students' knowledge recombination — meant to create new knowledge— implies greater learning and, for Piaget, it defines the very essence of active learning.

In the proposed model, the knowledge created in phase 5 is called 'lesson learned' (Sein-Echaluce, Fidalgo-Blanco, & García-Peñalvo, 2016), and it is used as a learning object in both ways for other subjects or for the same subject in a later call. Knowledge creation from experience-based knowledge is considered a basic pillar for the sake of the organization's ongoing improvement (Nonaka & Takeuchi, 1995; Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2014; Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2015a). In this case, the organization is the subject itself.

The learning object created —lesson learned— is asynchronously used with other students. Therefore, asynchronous peer-to-peer learning is taking place through lessons learned (Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2017).

This cycle can be repeated as many times as desired if both goals are to be achieved: to continue to deepen in specific knowledge or to start working on new knowledge related to previous one (Sein-Echaluce et al., 2015).

The cycle idea is based on knowledge recombination as a method that promotes learning (Piaget, 1964).

## Integration of the RT-CICLO Model With the Active Flip Teaching Method

On the one hand, previous studies proved that the developed MFT method (Sein-Echaluce et al., 2015) kept students active during the two phases of the Flip Teaching method ─lesson at home and homework in the classroom.

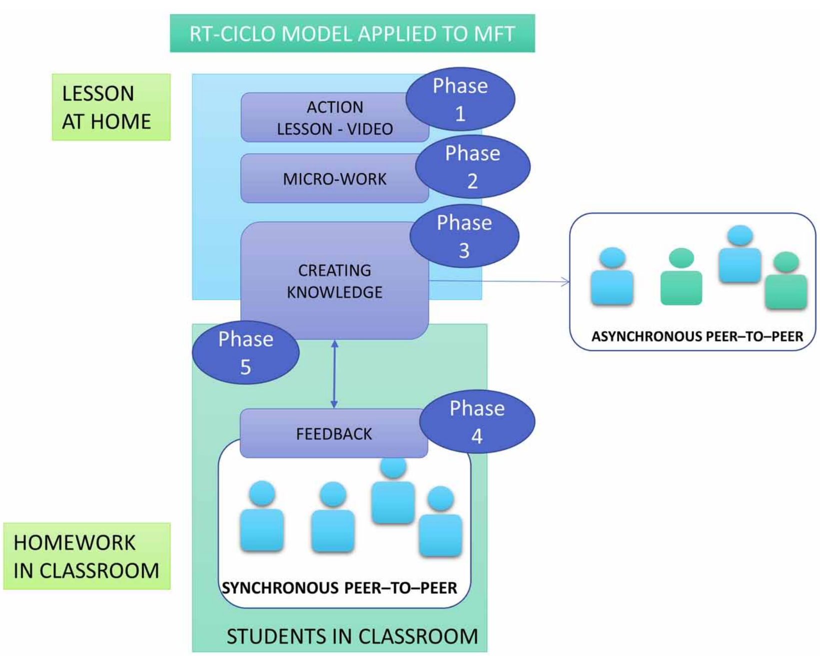
On the other hand, previous research studies demonstrated the usefulness of both synchronous (Sein-Echaluce, Fidalgo-Blanco, Esteban-Escaño, et al., 2017; Fidalgo-Blanco et al., 2018) and asynchronous (Sein-Echaluce, Fidalgo-Blanco, & García-Peñalvo, 2017), peer-to-peer learning, within the Flip Teaching method. This process is known as APFT (Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2017).

The novelty of the present study is to relate all previous research in order to create an integrated RT-CICLO. Figure 3 shows the integration of MFT + APFT with RT-CICLO.

The equivalence of the phases for the RT-CICLO model, explained above, after the integration of the MFT and APFT models, is described below.

**Phase 1 equivalence:** Videotape the lesson in the RT-CICLO model. The characteristics of the video are similar as a master lesson and it should not exceed 10 minutes. The video content provides the conceptual basis for students to perform a specific action autonomously.

*Figure 3. Integration of MFT, APFT and RT-CICLO models*



**Phase 2 equivalence:** Micro-work in the RT-CICLO model. A micro-work is performed by students ─individually or cooperatively─ either as part of a larger duty or as a single duty.

**Phase 3 equivalence:** Knowledge generation in the RT-CICLO model. The knowledge generation model is based on sharing the result obtained during the micro-work creation. The outcome result can be qualified with different degrees in terms of academic assessment ─ on a 1-10 scale, for example─ showing the quality of the created knowledge.

**Phase 4 equivalence:** Feedback in the RT-CICLO model. Resources created in phase 3 are used as learning resources. Therefore, knowledge categorized as low quality ─for example 2 marks─ will be used by teachers to attain a number of aims: identify errors, and indicate concepts that have not been taken into account, among others. Teachers will decide the results that should be used to give feedback. It is recommended to use the following three types of results: the wrong result (lowest quality), one that is average (medium quality) and the correct one (higher quality). Synchronous peer-to-peer learning takes place in this phase.

**Phase 5 equivalence:** Improved knowledge creation in the RT-CICLO model. Students improve and increase the knowledge generated in phase 3 from the feedback obtained in phase 4. Improvement is possible through the modification of the knowledge and the incorporation of the experience and justification of the changes made. We call this knowledge as 'lesson learned'.

### Main Contribution of the RT-CICLO Model in the MFT / APFT Model

In the MFT/APFT model (figure 3), the knowledge creation was done in two phases. However, the result of each phase was not only stored in different places, but it was also used in different contexts. The knowledge created is used ─both face to face and in a synchronous way─ to produce peer-to-peer learning in phase 3. While in phase 4, the knowledge is used not only in the same subject but in later academic courses, as well.

Much the same as in the MFT / APFT model, the model knowledge is created in two phases. However, it unifies the storage location and its use in the subject. Knowledge generated in phase 2 ─lesson learned─ is used in the same subject being as a reference to students who have not generated it. Therefore, students ─either individually or in groups─ share their lessons learned. This, however, does not mean that the RT-CICLO model cannot be used as in the MFT/APFT model ─i.e. using lessons learned in different subjects in which it was generated.

The application context of the aforementioned model is explained in the next section.

## APPLICATION CONTEXT

During the 2017-2018 academic year two experiences were carried out in order to apply the model. The first one was performed in the subject 'Fundamentals of Programming' (FP), taught during the first semester of a freshman course included in a degree in first year of Biotechnology. The second experience was applied in the subject 'Computer Science and Programming' (IP), taught in the second semester of another freshman course included in Energy Engineering. Both degrees are part of the curriculum taught in the Polytechnic University of Madrid.

The model was applied in both subjects in a module working on the teamwork competence formation (TWC). The training process is known as Comprehensive Training Model of the Teamwork Competence CTMTC (Leris, Fidalgo-Blanco, & Sein-Echaluce, 2014). The main characteristic of this method is to permit the follow-up on the work team from the beginning to the end of its development (Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2015). In addition, the method applied allows students to be trained and evaluated in individual competences. This serves to identify students' passive or active attitude; the group competences, that is to say, own and characteristic of teamwork competence; and final results, which define final work quality.

For the first experience −applied to the FP subject− knowledge generated by students in phase 5 was not managed in order to be used as resources of the subject itself. It was due to the fact that this knowledge was presented as a final result complement. Consequently, it could not be used throughout the training process.

In the second experience −implemented in the IP subject− lessons learned generated in phase 1 were used. Knowledge generated in phase 5 −as lessons learned− was also applied during the development of subject itself. To this end, a social network that served as support was implemented. In this way, students could share knowledge while creating it. Generated knowledge was delivered before completing teamwork, as in experience 1. However, the proposed model was fully used in this case.

In experience 1, 114 students have participated in 19 teams with 6 students per team. However, the number of students involved in the second experience was 70 organized in 12 work teams.

Student active participation in experience 1 was measured through a survey already used in previous research (Fidalgo-Blanco et al., 2019). In this survey, questions associated with active participation are asked.

In experience 2, a survey different from the one used in experience 1 was used in order to measure an active participation methodology (Rodríguez-Conde, García-Peñalvo, & García-Holgado, 2017). This survey has been previously used in research studies in order to measure the use of a resource search engine generated within the context of a given subject.

The results in both experiences through the students' survey answers are shown below.

## RESULTS

First, selected questions from the measurement tools –i.e surveys used in each experience− are outlined as follows.

### Measurement Tools Description

#### Experience 1: Survey A - Measurement of Teamwork Characteristics

*Survey A:* At the end of the FP subject implementation −for experience 1− a survey was delivered in order to measure several aspects related to TWC. The following survey-related questions have been selected and numbered in a specific way:

- **Q1.** Was there anyone in your team who has tried to avoid his/her responsibilities? (answer YES / NO)

- **Q2.** Have the regulations created by your team been met? (answer YES / NO)
- **Q3.** Value your agreement level with the following statements about your teammates. 5-Likert scale value (1-Totally disagree to 5-Totally agree).
  - **Q3.1.** They have followed the leader's instructions.
  - **Q3.2.** If problems have arisen, they have helped to solve them.
  - **Q3.3.** They have performed tasks assigned on the map of responsibilities.
  - **Q3.4.** They have completed on time tasks and activities under their responsibility.
  - **Q3.5.** They accept the team leader.
- **Q4.** How have your work team decisions been made? (Answers: Cooperatively by all team members - Cooperatively among the most active team members).

### Experience 2: Survey B- Measurement of an Active Methodology

*Question Q10:* Students' perceptions of the active methodology

- **Q10.:** Perception of the active methodology. Assess the extent to which you agree or disagree with the following questions (Likert scale: 1=totally disagree to 5=totally agree). The question Q10 measure students' perceptions of the active methodology using a validated tool (Rodríguez-Conde et al., 2017). Some questions from the pre-test were excluded in the post-test, they are not included in the following list.
  - **Q10.1:** This learning methodology (online videos and discussion of the results in class organised in the repository) was useful to me in order to develop a better understanding of the contents.
  - **Q10.2:** The teacher helped me to understand the content through the use of the repository.
  - **Q10.3:** I think that this methodology lets me achieve the learning objectives.
  - **Q10.4:** I like this system as an aid to learning.
  - **Q10.5:** I am pleased with the teamwork.
  - **Q10.6:** I have the perception of learning to work on a team after this experience.

## Results of Each Experience

### Experience 1: Survey A (Teamwork)

The participation of the students in the survey was 72% −i.e. 82 answered surveys out of 114. The results obtained for questions Q1, Q2 and Q4 of survey A −detailed in section 4.1.1− are shown in graphs in figure 4.

### Experience 2: Survey B (Active Methodology)

With regard to experience 2, survey B has been completed by 40 students out of a total of 70. Therefore, the participation accounts for 57%. The results of Q10 question are shown in figure 6.

*Figure 4. Results of questions Q1, Q2, Q3 of teamwork survey in experience 1*

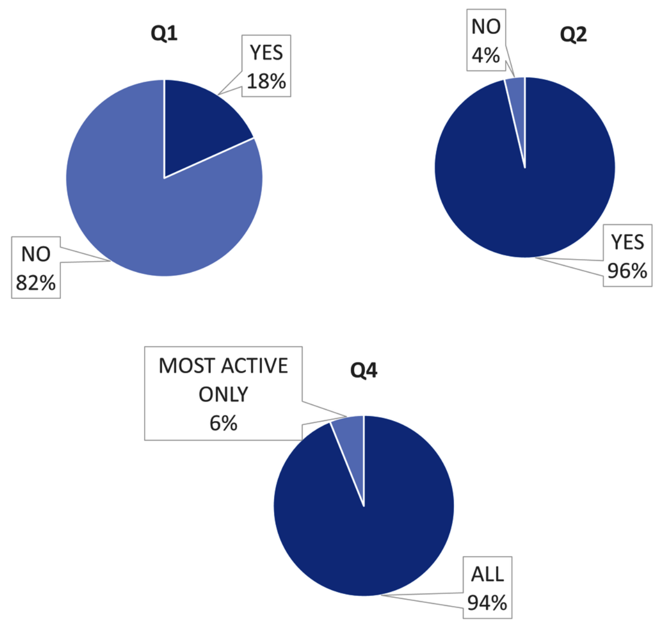



*Figure 5. Results of question Q3 of teamwork survey in experience 1*

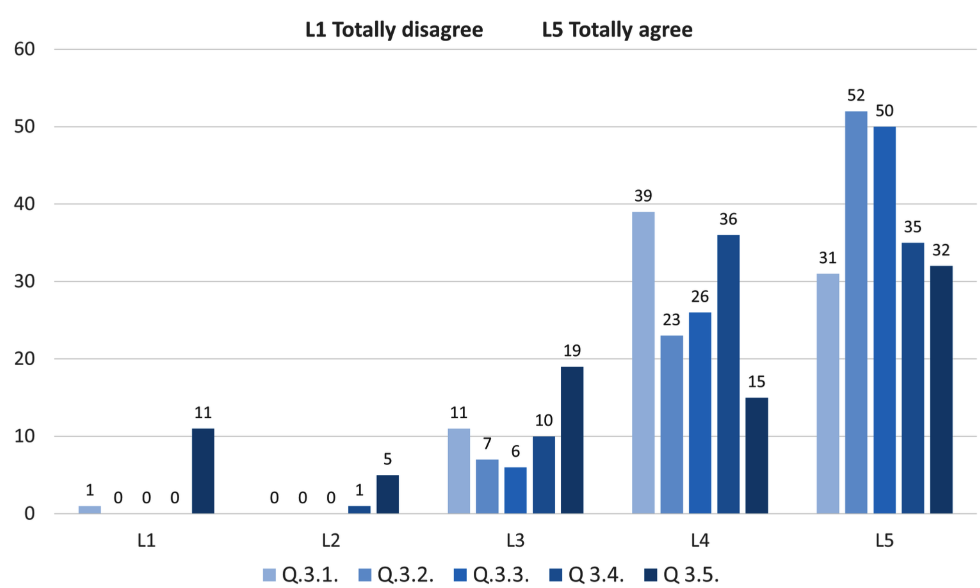


*Table 1. Distribution of Q3 answers for each 5-Likert scale value (1-Totally disagree to 5-Totally agree)*

| Q3% | L1 | L2 | L3 | L4 | L5 |
|---|---|---|---|---|---|
| Q.3.1. | 1.22 | 0.00 | 13.41 | 47.56 | 37.80 |
| Q.3.2. | 0.00 | 0.00 | 8.54 | 28.05 | 63.41 |
| Q.3.3. | 0.00 | 0.00 | 7.32 | 31.71 | 60.98 |
| Q 3.4. | 0.00 | 1.22 | 12.20 | 43.90 | 42.68 |
| Q 3.5. | 13.41 | 6.10 | 23.17 | 18.29 | 39.02 |

*Figure 6. Results of question Q10 of the active methodology in experience 2*

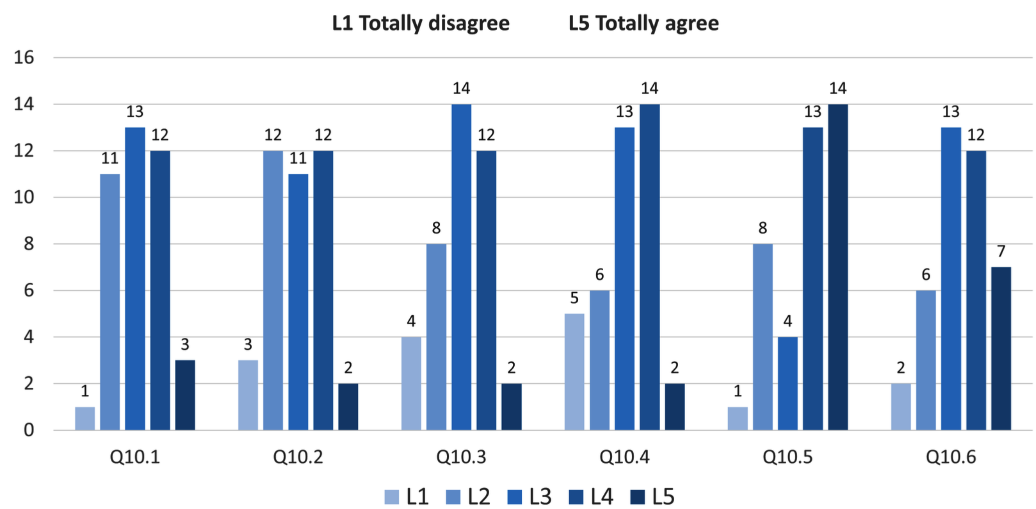



*Table 2. Distribution of Q10 answers for each 5-Likert scale value (1-totally disagree to 5-totally agree)*

| Q10% | L1 | L2 | L3 | L4 | L5 |
|---|---|---|---|---|---|
| Q10.1 | 2.50 | 27.50 | 32.50 | 30.00 | 7.50 |
| Q10.2 | 7.50 | 30.00 | 27.50 | 30.00 | 5.00 |
| Q10.3 | 10.00 | 20.00 | 35.00 | 30.00 | 5.00 |
| Q10.4 | 12.50 | 15.00 | 32.50 | 35.00 | 5.00 |
| Q10.5 | 2.50 | 20.00 | 10.00 | 32.50 | 35.00 |
| Q10.6 | 5.00 | 15.00 | 32.50 | 30.00 | 17.50 |

## CONCLUSION

Regarding experience 1, as shown in a number of previous papers, the proposed model is active (Fidalgo-Blanco et al., 2019). Therefore, the present study has not focused on this issue but on asking students about different active habits associated with learning. Since these habits should be acquired from the beginning, questions related to different moments of TWC-based learning were asked.

Teamwork involves an individual responsibility, so its completion indicates an active habit. Each teamwork member should not only comply with certain rules, but he should also perform his work part and complete his responsibilities in the team. In terms of individual participation, data about the acquisition of active habits have been provided by questions Q1 (if responsibilities are not taken up), Q2 (compliance with regulations), Q3.3 (completion of assigned responsibilities) and Q3.4 (performing assigned tasks on time). Regarding survey A, 82% of the students surveyed answered that team members have not tried to avoid their responsibilities (Q1). In addition, 94% indicate that team members have complied with regulations (Q2) and 100% say that assigned responsibilities have been completed (Q3.3). What is more, 98.7% indicate that team members have performed their assigned tasks on schedule (Q3.4).

Nevertheless, in teamwork development not only are individual attitudes enough, but an active habit in terms of cooperation should also be shown. In order to measure the aforementioned habit, two questions have been asked: Q4 ─team decision-making procedure─ and Q3.2 ─contribution to problem-solving. In both questions a high percentage of agreement has been obtained. Since 94% indicate that decisions have been taken cooperatively ─every team member has been involved in them─ and 100% answered that every team member has contributed to solving problems.

At the same time, team leaders often have higher active participation since they have an extra responsibility. For this reason, a habit that should be double-checked is the relationship between the team leader and the rest of the team members. In this sense, the following two questions were asked: Q3.1 −follow up of the leader´s instructions− and Q3.5 −accepting the leader. Specifically, as shown in experience 1, 98.7% have followed leader's instructions and 80% have accepted the leader's role.

Thus, high percentages suggest that this active method favors the creation of an active participation habit among students both on a personal and group level. In experience 2, a survey that measures an active methodology has been applied. In this experience, the activity associated with phase 5 was specifically assigned, since previous research has shown that the model followed is in line with the active method (Fidalgo-Blanco et al., 2019).

In experience 2, the MFT / APFT model was applied in two thirds of the IP subject. At that point, the RT-CICLO model was applied for the first time. The main goal set for this new model is to include the knowledge generated by the students as a learning resource in the same subject and in real time –i.e. from the very time it is created.

Survey B was applied to measure how this knowledge was included as part of the learning resources. In other words, the contribution made by the model in the active MFT / APFT methodology was measured.

The positive answer percentages obtained for all the questions −Q10.1 to Q10.6− have been over 70%, except for Q10.2 (62.5%). In Q10.2, students were asked about the help supported by teacher for understanding the methodology. However, in experience 2, the teachers did not carry out any action to explain the new phase, so the phase was only activated, and the students were informed of its existence. This accounts for the lowest result in Q10.2, although it could have been even lower.

The results with the highest positive answer percentage pertain to questions Q10.5 and Q10.6. Regarding question Q10.5 –i.e. asking about students' perception as regards how helpful the method has given in their learning− not only 77.5% gave a positive answer but also 67.5% showed that they completely or mostly agreed. The results in question Q10.6 are also relevant since 80% of the students agreed that they had acquired the teamwork competence through the use of this method. In addition, 47.5% saw that they have achieved the aforementioned competence in a remarkable way −answering that they completely or mostly agreed.

Thus, most students felt that this method has served to achieve the final goal set as part of their teamwork ─i.e. performing well and acquiring the required competence. Results obtained therefore seem to demonstrate the use of the created synchronized knowledge has had impact, once feedback and reflection obtained in phase 4 have taken place.

As explained above, previous research demonstrated that the MFT model can be considered as an active learning method. In addition, the present study has shown that this model also favors the creation of an active habit in students, both individually and as a group. What is more, this research has shown that adaptation of the MFT / APFT model to the general active learning model –called RT-CICLO– does not modify its use capacity within an active methodology. And in terms of students' perception, results may confirm that this model helps to obtain a satisfactory result in the work and to acquire TWC.

As far as further research is concerned, we intend to use the whole model from the beginning of the subject. Apart from this, the implementation of a joint use of both models −whole model and MFT / APFT method− is also planned. We also intend to use this method in other contexts, such as those in which there is no teamwork or even those in which the Flip Teaching method is not put into practice. In this way, the application of the RT-CICLO model in other situations can be assessed.

## ACKNOWLEDGMENT

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