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MAIN: Method for Applying Innovation in educatioN

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ABSTRACT

Planning any educational innovation experience, foreseeing its results, following an effective and efficient application of the method, and even transferring it, may be difficult due to its creative character. The MAIN method (Method for Applying Innovation in educatioN) is a modeling method that allows the planning, implementation, and dissemination of educational innovation. This work presents the different steps that make up the method above: the used methodology, the included duties, the needed effort, the technological background, and its impact prediction. This paper presents a specific application of the MAIN method to solve the absence of active learning in students, and it uses the Flip Teaching method, as well as a scientific dissemination strategy of that innovation.

CCS CONCEPTS

• Applied Computing→ Education→ Collaborative learning

KEYWORDS

Educational innovation, Flip teaching, Scientific dissemination

1 INTRODUCTION

Understanding the meaning of the educational innovation is simple if we rely on the multiple definitions. For example, Sein-Echaluce. Fidalgo-Blanco and Alves [14] say that "Educational innovation is the application of an idea that produces planned change in processes, services or products that generate an improvement in the training objectives." Following definitions of educational innovation, teachers experiment by making changes that produce improvement in their environments. However, some of these experiences are not real innovations. They are not good practices of educational innovation to be transferred to other contexts, or the improvement is not seriously proved (they depend on the perception of the teachers) or the experiences imply much more effort and work for students, and it negatively affects to the rest of the subjects, for instance [17].

One of the main problems of educational innovation is that the teachers have no trails or guidelines to plan, measure and spread it. All of those facts lead to difficulties for academic institutions (regional, national and international) to recognize the innovative work carried out by the faculty.

Despite all of this, the number of teachers that innovate is increasingly more in the last years. They share their experiences through Web 2.0 and face-to-face or virtual meetings.

The MAIN method (Method for Applying Innovation in educatioN) was introduced by Fidalgo-Blanco, Sein-Echaluce & García- Peñalvo [6, 8] to address the absence of guidelines in educational innovation. This paper presents a complete version of this method.

The MAIN method allows:

- Identify a learning situation to be improved.
- Identify the most suitable innovations (and even to design new ones).
- Recognize and relate the activities that need to be carried out by teachers and students.
- Identify the functionality and mission of the involved technology.
- Identify the effort and technological skills required in the experience (for teachers and students).
- Provide educational innovation and technological innovation independently.

- Apply multiple strategies: change of the student's and faculty's role, transference of the accumulated experience (in any subject) and scientific dissemination.
- Expected outcomes and impact.

MAIN works with consolidated educational innovation models and with trending models, making mixtures of them to plan future innovations. The method is organized into three connected modules (planning, implementation, and strategy), which can be applied in any field of knowledge and learning context.

Section 2 introduces the MAIN conceptual model, and section 3 includes a specific case based in one of the current tendencies in educational innovation: Flip Teaching or Flipped Classroom. Some results and conclusions about the application of the proposed MAIN method, are included in the last sections of the paper.

2 MAIN model

The MAIN model consists of three conceptual modules that belong to the stages that all the teachers need to keep in mind before carrying out an educational innovation experience [6]:

2.1- Planning module.
2.2- Implementation module.
2.3- Strategy module.

2.1 Planning Module

The aim of this first module is to identify measurable improvements that allow teachers to know if the innovation that they want to make meets their needs (the impact of the innovation). With that purpose, it is necessary to previously identify the root problem, the target group to which the action is focused and the consequences of the root problem in the target group.

2.1.1 Identification of the root problem

MAIN allows identifying the regular problematic that negative impacts into learning. An uncertain situation occurs due to the called 'root problems,' whose characteristics are the following:

1. They are present in all the educational environments and levels.
2. They are the raw material of the educational problems, so they cause other issues.
3. Educational models or teachers (not students) are usually considered as the origin of the educational problems.

Two educational problems: lack of motivation and passive behavior from the student body, are examples considered here to illustrate the characteristics of 'root problems.' In the first example, 'lack of motivation' in the student body is common at any educational level. The students' demotivation can be due to several causes such as low previous knowledge of students (it swiftly produces demotivation). Therefore, lack of motivation is a usual problem but not a root one.

In the second example, the 'passive attitude' fulfills the characteristics of a 'root problem.' Indeed, the passive attitude is a general problem and may cause other problems like the demotivation, mainly in the master class. Furthermore, the student body is not the problem, but the educational model (sometimes overly focused on teachers) and the teachers who do not usually apply active methodologies to create an active habit. Therefore, the passive attitude of students is a 'root problem.'

2.1.2 Target group

It is referred to the characteristics of the students to whom the innovation will be applied. The group can be formed by all students (for instance, when the participation is not active) or by students' groups with similar characteristics (such as the groups with the same level of previous knowledge). In any case, it is essential to identify the symptoms presented by the students who have the root problem.

2.1.3. Consequences of the root problem in the target group

This section is usually easy for teachers because they exactly know what happens to the students and who have the root problem, regarding learning and even behavior.

2.1.4 Impact of the innovation

It is necessary to identify some indicators to measure innovation results (associated with people, such as motivation, or with the creation of knowledge) and to measure this impact on the learning results (associated with the content or academic achievements). Previous sections 2.1.2 and 2.1.3 make it easy to identify measurable improvements.

2.2 Implementation Module

The primary mission of the implementation module is to guide both, the preparation and implementation of the educational innovation process. This module is divided into two phases: identification of the innovation method and definition of the functional model.

2.2.1 Identification of the innovation method

In this phase, the teacher identifies educational innovation validated and contrasted models, which drive to the chosen target audience and achieve improvements in the same identified root problem. This phase can also be used to create a new method of innovation from other already known.

2.2.2. Definition of the functional model

Once the innovation method has been identified and chosen, it may be analyzed to obtain the functional model. The processes can be conceptual (they express the idea of the educational innovation selected method) or functional (they group a set of activities that students and faculty need to do to achieve a particular goal). For each useful model, the mission of the technology, required for each functional component, is identified and supports teachers and students' actions.

The functional model allows teachers to identify the impact of the proposed educational innovation in the learning context. It also rates the effort that the inclusion of this innovation takes in the background and be aware of the methodological changes to make. This model is similar to a cooking recipe, the ingredients,

the activities to be carried out with the components and the tools to carry out the operations (technology) are identified.

2.3 Strategy Module

Once the functional model is identified, along with the desired impact, it is necessary to apply a set of strategies and the three most important are the following: change of role, good practice in educational innovation and scientific dissemination.

2.3.1 Strategy "Change of role"

Same educational model with the same technology may be a success or a failure; the success depends on the strategy with which we use model and technology. It is imperative to identify the habits acquired and, based on them, applies planning to introduce new practices. The strategy for changing habits requires new roles of both, teachers and students.

2.3.2 Transferability of innovation

An educational innovation experience is a good practice not only by their impact on the improvement of the results (effectiveness) but by their efficiency, sustainability, and transferability. This last feature means that an educational innovation experience, on a specific subject, should be able to transfer to any other subject, even in a different area of knowledge or education level. This type of dissemination is still relatively unknown, and it is based on identifying and measuring the impact on the educational process, student profiles and specific learning contexts.

2.3.3. Scientific dissemination

Disseminating the innovation in conferences and scientific journals implies that the research should be done through the knowledge of the state-of-the-art, scientific analysis of evidence and use of validated measurement tools [18, 19]. Teachers should use scientific methods in carrying out educational innovation, creating innovations or applying existing ones [1, 12]. In this case, therefore, the dissemination is carried out through reports, books, and articles and its quality indicators impact in the educational system, being references in the specific research field, not in the change of the educational model.

3. MAIN method: A case study

This section presents an example of the MAIN method for a specific case that currently presents general interest for teachers. This case is presently being held in some courses and workshops about the need of active learning methodologies and implemented in several Spanish universities (Universidad de la Coruña, Universidad de León, Universidad de Salamanca, Universidad de Vigo, Universidad de Zaragoza y Universidad Politécnica de Madrid). The next sub-sections include, for this specific case, the three modules that compose the MAIN method: Planning module, Application module, and Strategy module.

3.1. Planning module in the case study

The needed steps to plan the innovation in this specific case have been obtained from the comments of the faculty that has participated in the MAIN courses mentioned above.

The phases of the planning module, explained in section 2.1, are the following in this specific case.

3.1.1. Identifying the root problem

- Passive attitude of students.

3.1.2. Target group

Identification of attitude in theoretical learning situations (example: master class)

- Students do not ask questions.
- Students do not participate in debates.
- Students do not do proposed activities.
- Students do not participate in class.
- Students easily distract.
- Students have not interested in the subject.

3.1.3. Consequences of the students' passivity

- Students do not keep up with daily school work.
- Low students' participation in group activities.
- Students have not a practical view of the subject.
- Low students' attendance at the lectures.
- Students' dropout.
- A low interaction between students.

3.1.4. Expected impact of the action

The purpose of this educational innovation experience is the improvement of the following aspects:

- An increase of questions, debates, reflections, knowledge (creation, cooperation and transference) and voluntary attendance at classes.
- Improvement of academic results on theoretical knowledge.
- Improvement of student-student interaction.
- The validity of resources created by students.
- A positive impact of feedback on learning improvements on complex knowledge.

The phase 3.1.1 is used to identify a learning situation which is associated with a root problem and needs to be improved. In this case, it is a very common situation that affects most of the students, mainly in subjects (or parts of it) with a theoretical characteristic. Usually, the passivity of students is related to decreased motivation for the learning process, weak learning (for example, with poor retention of knowledge), poor development of cognitive capacities and low autonomous learning. The greater the involvement of students in their learning process, the more effective and efficient this learning is from the emotional and cognitive points of view. Therefore, "learning by doing" improves learning because it implies a higher number of cognitive actions [3, 4].

The target group (second phase) is formed by all the students of the specific subject in this case, since this situation (the passivity) is usually the majority, mainly in lectures (and it does not harm to the active students). However, the list of indicators, previously included in 3.1.2, help recognize this type of audience and can be used later to identify the measurable impact.

The third phase (3.1.3) shows a list of consequences that inactivity causes in the students. All of them are related to

students' behavior inside or outside the classroom, if they: do not ask questions, do not participate in debates, do not do proposed activities, do not participate in class, are easily distracted or have not interested in the subject.

The fourth phase (3.1.4) shows the impact that the application of educational innovation would have to solve the root problem of this target group. In this case, the effect could focus on indicators of activity such as questions and answers from students to teachers or among them; debates and reflections on a particular concept; creation of knowledge by the students (individually or cooperatively); and sharing of knowledge among students. Likewise, the impact can be measured not only through the learning outcomes but also from actions: the interaction between students, the quality and usefulness of knowledge created by students or the increase in feedback.

3.2 Application module in the case study

The application module of the MAIN method is carried out in two phases. The first one is based on identifying and selecting a process of contrasted educational innovation. The second phase is used to perform a functional model of the chosen method that allows determining the activities to be carried out by students and teachers, as well as the most appropriate tools for this purpose.

3.2.1. Selection of the most appropriate innovation method

Firstly, it is necessary to identify some methods of educational innovation, validated by previous publications, to achieve the improvements sought in this learning situation. Consider, for example, five ways to improve the active participation of students: Collective Intelligence, Micro Flip Teaching, Challenge Cased Learning, Service Learning, and Problem Based Learning. These models are usually not exclusive and, for example, collective intelligence can be used along with Flip Teaching [10]. However, inexperienced teachers in educational innovation are advised to start with only a specific method.

The 'application module' of MAIN is based on identifying the processes involved in each method along with their relationships. Knowing the procedures included in different methods could allow their combination, as well as adding new means or replacing other ones. This makes possible to carry out innovation, in a simple way, in the educational innovation methods.

Simplifying the exposition, a single method of educational innovation has been considered in this case, Micro Flip Teaching (MFT) method [5, 7], which is a derivation of the Flip Teaching (FT) or Flipped Classroom method. The results of applying MFT to increase the active participation of students have been already validated [11].

Scientific publications will allow verifying that the chosen method has an impact similar to the one that is pursued. In this case, the MFT method has shown an effect identical to the presented in 3.1.4 [9, 13, 15].

Flip Teaching is characterized by the investment of the educational model, regarding the accomplishment place of two of the most common activities in the learning process: the lesson and the duties. The investment of the model is based on that the lesson is done at home and the homework is done in the classroom.

The second phase of the 'application module' is explained in the next sub-section.

3.2.2. Functional model

The model is usually presented depending on a tool to be used, on a specific action or on both. For example, figure 1 represents the application model of the MFT method under this point of view. Activities are associated with specific tools (video, text, etc.).

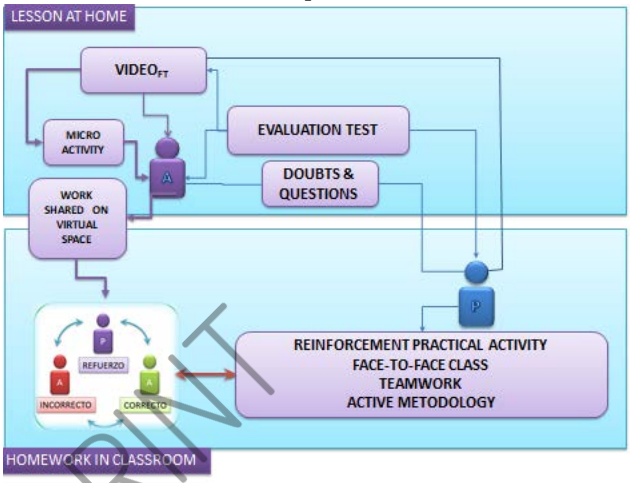

Figure 1: MFT Application Model.

This is a classic view of the Flip Teaching method in which teachers must create videos and include forums to solve questions and questionnaires for the assessment. Also, students perform a work (individual or cooperative) outside the classroom and, in the classroom, work with the results of the previous work, based on positive or negative feedback from teachers. Subsequently, teachers continue the classroom session with any active methodology. Table 1 shows those traditional activities of this model. The first row shows the first vision of the Flip Teaching method and the following rows show the actions that teachers and students should carry out.

Table 1. Classic activities in the MFT method

Home Lesson	Homework in classroom
Students watch a video	Students present the work
Students make questionnaires	Students take part in debates
Students use a forum for doubts	Teachers take part in debates
Students do a work	Face-to-face class continues with feedback and a cooperative way

This representation of the model is skewed and often induces confusion. For example, some educational innovation experiences, presented under the use of Flip Teaching method, merely consist in two aspects: teaching staff makes videos and, at best, students

watch them. The MAIN method does not try to identify the used tools but the conceptual and functional vision of the different processes. Activities are associated with processes (acquisition of knowledge through the video, etc.). Figure 2 represents the model based on the MAIN method for Figure 1.

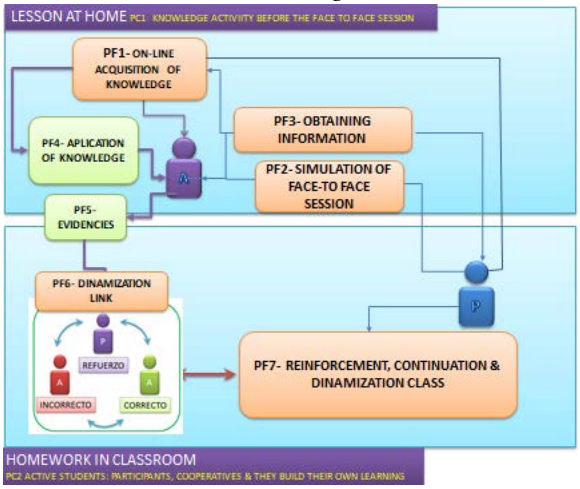

Figure 2. MAIN model for MFT.

The MAIN functional model firstly identifies conceptual processes that define innovation, as it is shown in the first row of Table 2 (PC1 and PC2), and the following rows show functional processes, where their primary mission are identified (PF1, PF2, etc.).

If this approach of the MAIN method is not made, any other model can lead to a very rigid interpretation. For example, it is widespread that in experiences of Flip Teaching method only videos are made, while the important thing is to get the students will be able to participate actively in the classroom, not the video.

Table 2. Conceptual processes of the MFT method from the MAIN model

Lesson at home. Conceptual process: PC1-Pre-sessional knowledge activity	Homework in class. Conceptual process: PC2-Active student participation
PF1- Knowledge acquisition	PF6- Link dynamization: Use evidence of the application of knowledge for faculty to make positive and negative feedback
PF2- Classroom simulation. Provide the students with the services they have in a classroom session: solving doubts, talking with colleagues and teachers, etc.	PF7- Dynamization of the class from the feedback obtained in the PF3 process. Reinforcement through micro-master lessons
PF3- Collect data from students. Feedback for students and teachers	
PF4-Application of knowledge acquired through an individual or cooperative activity	
PF5- Management of the evidences from the application of the method	

For example, the second column of Table 3 shows that the main characteristics of the traditional FT model are: "Teachers make a video," and "Students watch the video." The attention is usually put on the resource, the video, which often leads to the interpretation that it is necessary to make a video to carry out the lesson at home during the Flip Teaching method.

On the other hand, the vision of the MAIN method does not emphasize the tool (the video) but on the process to follow. In this case (column 3 of Table 3) the acquisition of has greater importance than the type of resource to be used (video, text, simulation, problem, etc.).

Concerning the technology, a classic model usually needs a specified technology. For example, use of the quizzes in the e-learning platform Moodle to perform an evaluation test and thus check if students have acquired the knowledge from the video.

However, by using the MAIN model, its functionality is based on collecting evidence of the learning, of the acquisition of that knowledge. In this case, some techniques can be identified to perform this function (questionnaire/query/survey/rubric/analysis of interaction data) as well as the possible technologies (form Google/Moodle/Kahoot/Socrative/Rubistar/Edpuzzle/Learning Analytics, etc.).

Table 3. MFT model activities based in MAIN

Activity	Traditional model	MAIN model
1-Teachers prepare online knowledge 2-Students access to on-line knowledge for learning	1-Teachers make a video. 2-Students watch the video	1-Teachers prepare accessible online knowledge (text, video, interactive program, personal learning system, simulation, problem, etc.) 2-Students interact with this knowledge through different technological tools, depending on the nature and type of resource prepared by teachers.

The advantage of not guiding the process to a specific technology (compared to the conceptual vision) is that it allows identifying multiple techniques and the available technologies

that make it possible. There are usually several technologies with the same functionalities. Therefore, it opens a range of possibilities for teachers to choose the best to suit their technological knowledge, availability or preferences. Also, if a technology disappears and another more innovative appears, the replacement can be done without any problem.

For example, a very consolidated form of learning information is through questionnaires. However, in contexts on-line the interaction of students with technology produces a lot of information whose analysis allows to obtain information from the learning process. This innovative approach is called Learning Analytics [16]. Therefore, the MAIN functional model is the same, independently of using a questionnaire or a learning analytics system [2, 20], since the function and mission of the technology are the same: to obtain information about the student's learning process.

3.3 Strategy module in the case study

Based on the scope of the innovation to be carried out, there are different strategies: change of role (affecting to a subject), transfer (affecting to an educational institution), dissemination (affecting to the scientific educational contexts).

3.3.1 Strategy "Change of role"

The main problem with the active methodologies is that students have no active habits and teachers have to break inertia and create a new one friendlier to the learning purpose. Therefore, the first or the second time the Flip Teaching method is applied, very few students have done the previous activity at home. It makes teachers to "force" the students to watch the video, for instance, by doing a test of that action in the classroom session. So, this action is not recommended since the education aim is creating active and cooperative habits among the students, by showing them that their active participation will imply a more attractive learning and better academic results for them. Therefore, there is a strategic process to create the habit among the students to carry out the previous activities before attending class.

This process forces teachers to change their traditional role during the first face-to-face sessions, and it also forces students to change habits. None of them will perform the same roles they had before carrying out the educational innovation experience.

3.3.2. Strategy "Transferability"

This strategy is based on the following facts: the impact is measurable, the effort needed to replicate the experience is not excessive, the experience is maintained without the need of new resources and investments, and it can be applied in different subjects and areas of knowledge. The functional model guarantees all of the above, it is similar to a cooking recipe and therefore it is easy to apply it in any other educational context.

3.3.3. Strategy "Dissemination"

This strategy is closely related to the previous one. If the experience of educational innovation gets improvements, teachers usually want to publish it in scientific contexts (conferences, journals, etc.), and some processes need to be followed in addition to the learning processes.

For instance, Figure 3 shows three scientific research scenarios, the most widely used in scientific publications which include innovative education experiences based on the use of technology.

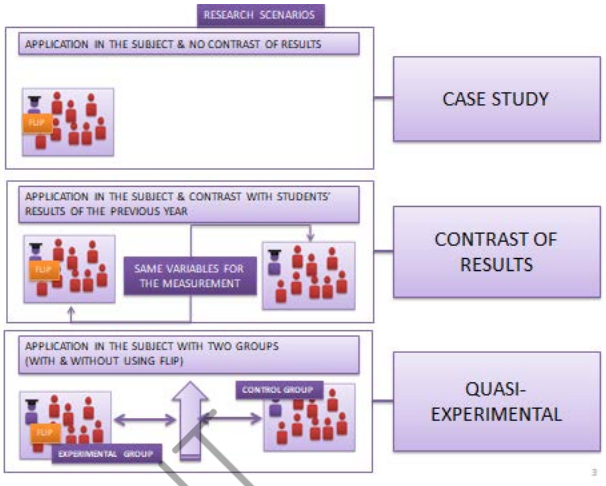

Figure 3: Scientific scenarios for the dissemination of educational innovation

Each of these scenarios must perform a set of sequenced over time steps that teachers should do. In that way, teachers should obtain measurable evidence, analyze them with validated tools and, based on them, draw some conclusions. For instance, and concisely, the "quasi-experimental" method requires evidence to prove that the experimental and control groups are homogeneous and that the learning processes of each group are also similar to compare the qualitative and quantitative results obtained in each group.

4 RESULTS

To check the teachers' perception of the applicability of the MAIN method (called MAIN FLIP), after each MAIN course a survey was fulfilled by participants to know the teachers' agreement the following eight questions:

- Q1. The MAIN FLIP can be used as a guide to do a Flip Teaching experience in different subjects.
- Q2. The MAIN FLIP allows previously know the impact that its application will produce.
- Q3. The MAIN FLIP is a useful tool to do Flip Teaching experiences.
- Q4. The MAIN FLIP offers different planning approaches depending on the final strategy.
- Q5. The MAIN FLIP supports technology evolution.
- Q6. The MAIN FLIP makes easy the methodological innovation of Flip teaching.
- Q7. The MAIN FLIP allows transfer Flip Teaching experiences between different subjects.
- Q8. The MAIN FLIP makes easy the subsequent scientific dissemination under the approaches of "scientific dissemination."

The survey was presented by 49 university teachers after the implementation of the MAIN course in the universities of Zaragoza, Salamanca, and Vigo and it was fulfilled by 41 teachers

The questions have been measured with a Likert range 5 (1- totally disagree to 5- fully agree). Figure 4 includes a boxplot diagram for the eight questions. It shows, except the Q2 question, that the 50% of participants gave a value 4 or 5 and at least of 75% gave a value from 3 to 5 for all the questions.

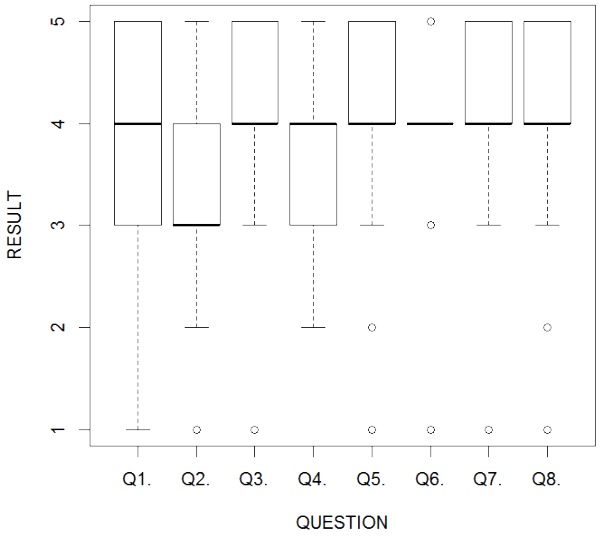

Figure 4: Boxplot diagram of the survey for MAIN FLIP

5 CONCLUSIONS

Some of the modules that make up the MAIN method are contributions specific to the method, such as the functional model. While others are taken from already consolidated and standardized models, such as the scientific dissemination module.

Likewise, each module might be used independently of the rest. However, the use of each of the modules in the already established sequence hold some benefits in comparison with the current way of carrying out innovative education.

The proposed method focuses the attention on the learning situation to improve and the target group who are affected by such improvement. Given that education has a set of learning problems that are common and widespread, some actions can be identified and planned for global solutions.

Another feature is the identification and classification of the most appropriate methods of educational innovation or those with proven efficacy, to solve the problems arising from this learning situation. This feature is significant because if a new trend of educational innovation appears, it can be included to improve the learning situation.

The MAIN method allows model each educative innovation in a set of conceptual and functional processes. It does it in such a way that the activities of students and teachers can be identified before applying the educational method. is allows having an idea of the effort, the change of the role of both students and faculty and the difficulty in implementing this innovation.

The mission of technology can be defined and associated to each conceptual process. Very often, when a technology becomes obsolete, all the innovations made with such technology are also outdated. The MAIN method is independent of the technological evolution because this method allows replacing the obsolete technology without negatively affecting the innovation.

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