Full length article

Collaborative learning and mobile devices: An educational experience in Primary Education

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ABSTRACT

In this paper we review the relevance of the models of Collaborative Learning (CL) in Primary Education, also exploring the integration of Information and Communication Technology (ICT) in these processes. Through the case study method, the main objective of this article is to describe the design, implementation and evaluation of a collaborative experience with ICT involving students in the 5th year of Primary Education in a Spanish school. Information has been collected from all those involved: teachers, tutors, teacher ICT support and students from two classes participating in the investigation. The results confirm the fact that ICT provide tools and channels that have multiplied the possibilities to carry out collaborative projects, providing quality assurance to share and communicate. The experience presented provides evidence to confirm this, and at the same time, confronts the dominant methodology based more on individual learning where the teacher continues to exercise the role of sole transmitter of knowledge.

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1. Theoretical framework

1.1. Introduction

Education plays a mediating role between the student and culturally arranged knowledge. Educating is a complex task that is subject to both internal influences to the educational process (social, cultural, family contexts …) and external ones (make up our professional heritage). For internal influences to be correctly carried out, they should take into account three relevant issues. Firstly, the objectives and curricular contents that we want to work with; secondly, the organizational context in which this educational process will be carried out; and, thirdly, the teaching strategies to be used to operationalize objectives and contents (Iglesias Rodríguez, 2010).

However, it must be remembered that education is a very complex and far-reaching process which has to be understood from a double perspective since values, customs and ways of acting are transmitted through education, and they will largely influence on the people around us. This is so because education does not occur only through words, but is present in each of the actions people perform and feelings and attitudes that everyone is capable of transmitting. The set of all these actions is what develops the individual capacities of the human being which, together with the influence of the environment on the person, give rise to learning (Rubia & Guitert, 2014).

In this regard, research and studies conducted by authors such as Vygotsky, Piaget, Freinet, Rousseau, Neill or Makarenko make clear the complexity of the learning processes that are associated with the ability of the brain to evolve, mature and develop its full potential, resulting in pedagogical models that favor these aspects in education through processes of cooperation and peer learning.

While it is true that learning is a process that the brain performs, it is also true that human beings learn in community by establishing both individual and group social relationships, communicating through the proper use of language and respecting the opinions of others. In short, we learn through dialogue, experience and research in the medium taking into account the peculiarities and contextual circumstances in which the educational action will be developed.

Therefore, a good learning entails (Iglesias Rodríguez, 2010, p. 128): (i) promote self-affirmation and positive self-concept as a

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precondition to appreciate and value others; (ii) develop confidence in oneself and in others as a way of facilitating the ability to share and communicate; (iii) strengthen the group and community feeling; (iv) develop the capacity of group decision making and conflict resolution; (v) promoting learning inquirer and/or rediscovery; (vi) strengthening the capacity of analysis, synthesis and inductive; (vii) develop pro-social behaviors; (viii) increase instructional time spent working in small groups and self-directed learning; (ix) take time to direct contact with students to guide instruction; and (x) review regularly not only the content but also the methodological strategies and evaluation procedures.

Without any doubt, the techniques that accompany this general orientation encourage participation, teamwork, cooperation and interaction. From a psychosocial point of view, and based on the proposals of the School of Geneva, it could be argued that the process of teaching and learning occurs through social interaction where the exchange of information of various kinds between two or more people leads to a confrontation of different views. This fact produces complex forms of thinking that cause conflicts and promote socio-cognitive mobilization and reorganization of existing intellectual structures, generating adequate intellectual progress in the subject (Black, Torrego & Zoriquiey, 2012; Ovejero, 2013). UNESCO, in 1983, clearly defines this way of working based on a socio-affective approach:

joint development of intuition and intellect aims to develop in students a fuller understanding of both themselves and others, by combining real experiences (as opposed to "classic" study) and analysis (p. 105).

The socio-affective method (Jares, 2002, pp. 243–269) calls into question the traditional way of learning based solely on the accumulation of information, without any personal experience whatsoever. The ideas do not penetrate the human being when they are only taught as theoretical ideas but when these are perceived by the person as an experiential learning from the accumulation of knowledge that is acquired throughout life, allowing the individual to analyze own and others' behaviors and feelings, as well as the implicit relationships that occurs in the communication itself. Moreover, the development of empathy (feeling of concordance and correspondence with another) and analytical contrast between experience and the surrounding world play an important role in this process. Therefore, one could say that the next steps for this type of learning to happen are fundamentally three: (i) experience of a real or simulated experience, which the individual shares as part of a group; (ii) a description and analysis thereof; and (iii) generalize and extend the experience to real life situations.

Since starting positions are experiences in which everyone can participate, and all do it in a same equality status, this method is motivating for all students, thus favoring the principle of inclusion.

In the light of these premises, the general objectives set for this research can be summarized as follows: (1) Determine the impact of collaborative work in the educational development and in the learning process, detecting advantages and disadvantages and generating ideas for the future to boost an educational system in accordance with the society nowadays; (2) Promote a methodological change in the classroom in line with 2.0 education and considering collaborative work as a facilitating tool. More specifically, these objectives can be itemized as: (a) Explore possibilities of collaborative work in the educational environment; (b) Ease the integration of educational tools and resources and investigate the possible pedagogical relationships established among them; and (d) Detect advantages and disadvantages to value the scope of these new teaching strategies from an empirical perspective.

1.2. Collaborative learning

When referring to the educational model that has guided this study, the terms cooperative learning and collaborative learning have to be borne in mind. However, in the literature there is no clear consensus on the specific use of cooperative or collaborative terminology in certain contexts. Although some authors (Crook, 1998; Dalsgoard & Paulsen, 2009; Guitert & Perez-Mateo, 2013; Holliman & Scanlon, 2006; Kreijins, Kirschner, & Jochems, 2003) establish clear differences between both, the reality is that in most of the works are used interchangeably. Accordingly, the definitions of both share a common core although there are different shades:

The essential difference between these two learning processes is that the [collaborative] first students are the ones who design their structure interactions and maintain control over the various decisions that affect their learning, while in the second [cooperative], is the teacher who almost completely designs and maintains control over the structure of interactions and the results to be obtained. (Paniz, 1997; quoted in Scagnoli, 2005, p. 7, p. 7)

From this viewpoint, cooperative learning is much more influenced and structured by the teacher. According Dillenbourg et al. (1996) cooperative learning requires a division of tasks between the group members and is usually the teacher who proposes the project work, distributes tasks and roles among group members. However, in collaborative learning there is a greater level of responsibility and autonomy of students. Gros (2000) notes that in collaborative learning the group decides how to perform the task, the procedures they will carry out, the division of labor, and the negotiation between the group members, which becomes fundamental. These conditions have resulted in the project being presented.

Collaborative Learning (henceforward CL) will be thus conceived in this work as the educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product. As Calzadilla qualifies, (2002, p. 4) the presence of group work does not imply that it is a truly collaborative practice, it is necessary for the group to become a team, there is an added value fruit of this cooperation. Consequently, in the CL environment, the learners are challenged both socially and emotionally as they listen to different perspectives, articulating and defending their ideas. In so doing, the learners begin to create their own conceptual frameworks so they do not rely on an expert's or a text's framework. In a CL setting, learners have the opportunity to talk to peers, present and defend ideas, exchange and question diverse beliefs, and are actively engaged (Marjan Laal & Mozhgan Laal, 2011; Srinivas, 2011).

Johnson et al. (1998) and Glinz (2005, p. 3) pointed out 5 basic components in Collaborative Learning, taking as departure point the idea that it is not simply a synonym for students working in groups. A learning activity only qualifies for a Collaborative Learning environment if the following elements are present:

- **Positive interdependence:** Members in the teams have to rely on one another to achieve the final objective. As a consequence, they are linked with others in a way that ensures that they all succeed together. If a member of the team fails to carry out his/her part, everyone suffers the derived consequences.
- **Relevant interaction:** Members help and encourage each other to learn by explaining what they understand and benefitting from shared knowledge. All tasks have to be developed interactively providing one another with feedback, challenging one another's conclusions and reasoning.

- **Personal responsibility:** All students in a group are responsible for the success of their share of the work and for mastery of all of the materials used.
- **Social skills:** Students are encouraged and helped to develop and practice trust-building, leadership, decision-making, communication, and conflict management skills.
- **Group self-evaluating:** Team members set group objectives and assess what they are doing well-what needs improvement or would change for the collaborative work to be carried out in a smoother way.

Therefore, CL represents a significant shift away from the typical teacher centered approach in school classrooms. In collaborative classrooms, the lecturing/listening/note-taking process may not disappear entirely, but it lives alongside other processes that are based on students' discussion and active work with the course material. Teachers who use collaborative learning approaches tend to think of themselves less as expert transmitters of knowledge to students, and more as expert designers of intellectual experiences for students. To learn new information or acquire new skills, students in a CL environment have to work actively in a purposeful way. They need to integrate the new material with previous knowledge, or use it to reorganize what they thought they knew. In collaborative learning situations, our students are not simply taking in new information or ideas, but creating something new with that information and ideas. Rather than beginning with theoretical ideas and then moving to practical examples and applications, collaborative learning tasks frequently begin with problems. Instead of being passive spectators of problems and solutions, students become immediate doers. Rich contexts challenge students to practice and develop higher order reasoning and problem solving skills.

As Jeff Golub points out, "Collaborative learning has as its main feature a structure that allows for student talk: students are supposed to talk with each other … and it is in this talking that much of the learning occurs." (Golub, 1988; cited in Smith and MacGregor, 1992, p. 2) Collaborative learning produces intellectual synergy of many minds coming to bear on a problem, and the social stimulation of mutual engagement in a common endeavor. This mutual exploration, meaning-making, and feedback often leads to better understanding on the part of students, and to the creation of new understandings for all of us (Goodsell, Maher, & Tinto, 1992).

1.3. The role of ICTs in Primary Education Schools

The development of learning with ICT has evolved from software supporting students' individual learning to more advanced micro-worlds, cognitive tools and learning environments. Especially the advantages of ICT for supporting students' collaborative learning have broken through with different ICT solutions that provide tools for collaboration both in the classroom setting (Valtonen, 2011).

Collaborative work through ICT means that students acquire an adequate degree of responsibility, sufficient to enable them to take their own actions, including apprenticeships, from an equal and shared responsibility (Paniz, 1997). To do this, technological resources should allow on one hand, that students can develop dynamic workplace where positive interdependence among members of the working group or class group is enhanced; and on the other hand, using the resources as support tools which neither interfere in the processes of interaction between peers nor in the organization, planning and joint resolution of their work. Meeting these requirements is not easy and will only be possible if educational activities planned promote students in both individual and group responsibility.

We agree with the Network of Collaborative Learning in Virtual Environments (RACEV), 2016 when they say that this type of learning is

> a shared process, coordinated and interdependent, in which students work together to achieve a common goal in a virtual environment. This learning is based on a process of action, interaction and reciprocity among students, facilitating the joint construction of meanings and the individual progress towards higher levels of development, in which technology appears only as working environment and the deeper technologies disappear (http://blogs1.uoc.es/racev/)

To carry out experiences of collaborative work incorporating ICT, there is therefore a series of minimum requirements that have to be met: the center needs to have adequate resources necessary for the implementation of the process, students and teachers must have a digital competence in this field high enough, the organization of the classroom must be adequate and finally, it is also necessary the school allowance to implement this methodology.

Similarly, meeting these assumptions implies that learning activities planned and developed in the classroom need to have a major innovative educational component that facilitates and encourages appropriate processes of reflection and self-learning in the students; and therefore, which get the participation and collaboration of all the people involved in the shared construction of knowledge, taking advantage of the many possibilities offered today by technologies (García-Valcárcel, Hernández, & Recamán, 2012; Sánchez, Iglesias, & Pedrero, 2014). Building knowledge is a complex process that requires a significant degree of responsibility from the teacher in training students in the domain of comprehension strategies and writing in different virtual environments in such a way that they can express their own ideas, defend them critically and accept, evaluate and exchange their own contributions and those of their peers, resulting in a reconstruction of knowledge and a joint search for various solutions for complex problems (Valverde, 2011).

The so-called new technologies therefore represent a challenge for the educational community. Firstly for teachers who firmly believe in the possibilities they offer for a better adaptation to different capacities, possibilities and needs of learners in different academic situations that occur in schools and classrooms. And secondly, for students who must learn to use ICT in an appropriate, thoughtful, critical and healthy way.

In short, that the center has been developing a model of integration of ICT in the teaching and learning process.

ICT lost a while ago the adjective new. Nowadays they should be fully integrated in all schools as a fundamental element. However, observing the reality of surrounding schools and analyzing the evolution of ICT implementation leads to the conclusion that it was neither a generalized nor a homogeneous process. Each educational administration has developed different types of programs with different approaches and processes for equipment provision and teacher training. Schools have thus been undergoing permanent ups and downs and vicissitudes. Gone are the days when many colleagues believed that the computer would be an area by specialists or "experiments" of those with more interest and concern on the issue and their "crazy stuff". The debate about whether there had to be responsible ICT centers (in Spain, each region it faced in its own way) has also vanished. Social reality and regulatory changes have made it clear that technological competition concerns all areas and all teachers (see Figs. 1–3).

However, no common standards have been provided to integrate ICT in schools. There is no obligation, for example, to have an ICT Plan. Each one has been doing it his own way. A turning point
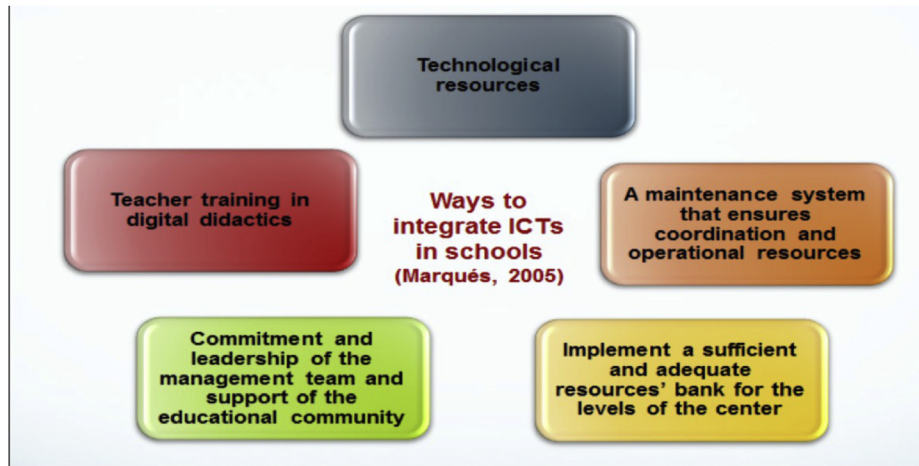
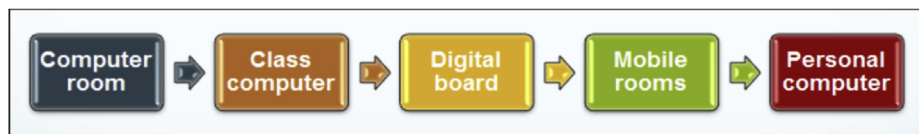**Fig. 1.** Marqués' steps to integrate ICTs at schools.

Fig. 2. Progressive phases in ICT incorporation.

Fig. 3. Process map used on the digital board to introduce tasks to students Authors' design.

was the launch of the Network Strategy XXI trying to universalize the presence of mini-notebooks in the third cycle of Primary Education but effective development was cut short by the crisis. However, not everything should depend on the initiatives of educational administration. Some centers believed in the need to develop their own process. Marqués Graells (2005) highlights five aspects to be taken into account to properly integrate ICT in schools:

The school of Early Childhood Education and Primary Education 'Almanzor' where we conducted the research we present in this article adequately meets these 5 criteria. 'Almanzor' is a publicly owned center belonging to the Junta of Castille and Leon, in which the teachings for the second cycle of Early Childhood Education (3–6 years) and the six courses of Primary Education (6–12 years) are taught. This center is located in Candeleda, a municipality belonging to the Community of Castille and Leon (Spain), located in the Tietar Valley, southwest of the province of Avila, on the southern slope of the Central System, particularly in Gredos mountain range. The center has 31 teachers for the stages of Early Childhood and Primary Education. All of them are directly involved in collaborative work with ICT, this fact promoting teamwork in a coordinated way although this process necessarily entails making time profitable, restructuring the work and unifying general aspects of methodology.

1.4. ICTs incorporation at the school

The incorporation of ICT is a process in which the school 'Almanzor' has a long history. Many years of pilot projects being carried out in this school have allowed them to have an equipment above average, and what is more important, to implement a very experienced methodology that has helped to maintain the highest level of certification. Level 5 was obtained together with the qualification as center of excellence in the application of information and communications technology in the first round of 2010, renewing it in 2012 and the last call 2014 (ORDER EDU/430/2014 of 30 May).

The presence of the school in the educational environment must be permanent and transversal. From this perspective, the team aimed to figure out the minimum that should be offered for a good "coexistence" of the factors involved in what is called the Theory of Iceberg: on the one hand, it facilitates the work of all those partners willing to "innovate", to try new things, take risks with new utilities and methodologies; but the school should also be provided with a common infrastructure that allows everyone to have the necessary resources to add to their teaching, so-called structured incorporation of ICT processes, and that should be common to all teachers in the school. For integration to be effective, structured processes, submerged part of the iceberg that guarantees stability, should reach 80% and live with 20% of innovation processes, visible, allowing the evolution and adaptation to permanent changes in the field of ICT.

Taking into account the aforementioned key aspects, School 'Almanzor' has developed a dynamic model which was adapted to the new equipment and trends. A model which is primarily based on teacher training at the school and on the implementation of institutional programs, the progressive integration of ICT in an organizational and methodological model, on the use of resources and on turning punctual experiences into widespread processes. In addition, the integration of ICT has been gradually incorporating to each of the new phases of integration the best experiences from the previous phase:

It has been said that education is always immersed in an ongoing a process of change that can be illustrated by the terminological evolution. In the beginning of virtual education, *e-learning* was adapted to school environments, to progressively soften it into the *blended learning* (b-learning) concept as a mix of physical and virtual presence that has led to the current stage of *ubiquitous learning* (u-learning) or *mobile-learning* (m-learning), which refers to

the use of mobile devices (smartphones, tablets, notebooks) in the practices of teaching and learning any subject or topic of interest, where the user fills spaces of time (on the way home or

between classes) that can be leveraged as practice times to improve their skills (for example in the use of English) by using applications (*apps*) that allow users to deepen contents dealt with in the classroom or to practice, for example, a language ability in an independent way, also providing a dynamic and active role to students in their own learning process. (García-Riaza & Iglesias, 2016, p. 20)

Without doubt, the rapid advance of technology will sooner or later reach a new paradigm for which there is not yet clearly a term coined. This new paradigm must respond to the demands of the applications to the school in the technological evolution era, which moves away from the traditional concept with which it began, based primarily on the use of computers, to be transformed into an open classroom, with instant access to all types of network resources through the student's personal device (an evolution of the current tablets). Through integrated apps, the students are offered numerous opportunities for individual and group work in the school environment. Apps also mean an extension of the classroom outside the school environment that maintains connectivity and interaction of the group, including the tutor, and gives a role to families (would be the dream of some parents, the replacement of homework by an online environment where the child continues tasks from class, shared and synchronized with peers and teachers).

So far, the virtual classroom has been the main driver of collaborative work through ICT at 'Almanzor' school, in which teachers have tried to pull together different technological applications (García-Riaza & Iglesias, 2014) that would allow students to create, classify and exchange contents generated by themselves. The collaborative use of these virtual environments has led to the development of group activities by areas of interest and/or topics, has facilitated the interdisciplinary work and has encouraged horizontal relationships between teachers and students. But we shall not forget that ICT have also favored the design of collaborative dynamics and study and research, have driven the collective production of knowledge, have offered a platform for versatile communication allowing different modes of interpersonal communication online, have heightened the sense of belonging to the group and led to the creation of learning communities, have allowed students and teachers to know and develop ways of teaching and learning not based on hierarchical positions. Moreover, the incorporation process we are referring to has helped students to have available a vast quantity of information and documents in various formats on topics of interest to them related to the course curriculum, what entails a better use of prior knowledge, interests, curiosity and the ability to scan each of the students participating in the development of a joint study project, thus altering the patrimonial conception of ideas (Levis, 2011, p. 12; Pedrero, Sánchez, & Iglesias, 2014).

In this sense, we can say that the use of learning environments by children in academic work as wikis, blogs, Google Site, Google Docs for questionnaires, Ipad applications to record videos, use virtual reality, scan QR codes or use i-movie have not only served, as indicated by Begoña Gros (2008, p. 97), to provide students with information concerning the processes that can be activated with a particular interface (functional performance) but also, and especially, have made it possible to create a competition in learners by turning them into committed and responsible users while they share information in a common code governing the interactions and shared by the same community (social benefits).

2. Materials and methods

The general objective of the educational experience here

presented was focused on getting information about the situation of schools regarding the development of collaborative learning strategies, on involving teachers in the implementation of these methodologies through ICT, on analyzing facilitating indicators in the learning process as well as the implications for students in competence acquisition.

To achieve the general objective earlier mentioned, and departing from a methodological point of view, the unavoidable dimensions of scientific research (Sánchez Gómez, 2015a, b, c) have been followed: Ontological, Epistemological, Methodological, Methodical (case study and presentation of case) and Strategic-technical (information collection techniques and data analysis).

The *ontological dimension* refers to the nature of reality, world-views. In this case, we do not consider it as individual or unconnected with subjects who posit it, opting for a critical realism (postpositivism), but is rather considered as a plural experience, socially and experientially constructed (realistic constructivism). It is, in short, prioritizing the choice of the subject and not the object.

The *epistemological dimension*, meanwhile, focuses on the answer to questions, narrowing what is considered as the nature of reality between knowledge and researcher. In this case, the para-digmatic option has been chosen (reading the world, science and interpretive phenomena) from meanings co-constructed by subjects: to describe and to understand.

With regard to the *methodological dimension* (reflection about how to obtain knowledge), it contains the design while maintaining consistency with the previous dimensions. This is an exploratory study which serves to increase the degree of familiarity with relatively unknown phenomena, to obtain information on the possibility of conducting a more thorough investigation into a particular context, to investigate problems of human behavior, to identify concepts or promissory variables, set priorities for further research or suggest verifiable statements (postulates) as in this case.

On the other hand, the *methodical dimension*, answers on the research method relevant for the study, gives coherence and consistency with the above dimensions and enables to decide which structured path should be followed to obtain knowledge. To achieve this purpose we used the case study exploratory method, conducting a thorough analysis of collaborative learning experiences mediated by ICT. These experiences were carried out in a school accredited with Level 5 in ICT use by the regional government (Junta de Castille and Leon, Spain): Primary Education School 'Almanzor' (Candeleda, Avila). In this research the full potential of collaborative learning activities is presented, describing the educational variables that are favored by the use of these learning methodologies, such as autonomy to find information, interactivity, capacity to select resources, creativity, social competence, cultural, linguistic and communicative competence (improving reading and comprehension of texts), personal initiative and motivation generated in students. Similarly, some reflections on the problems and limitations that arise in the application of such methodologies are also introduced.

The case study is one of the most characteristic forms of idiographic research (focused on the individual or on a specific case). Following Merriam (1988, pp. 11–13, cited by Rodríguez Gómez et al., 1996, p. 93), the four essential characteristics of the case study would be: unique, descriptive, heuristic and inductive. The case study is unique because it focuses on a situation, program or event; it is descriptive because it seeks for a thorough and intensive description of the phenomenon studied; it is heuristic as it tries to provide a full understanding of the case, what may lead to new meanings or to the ratification of what is known; and, finally, it is inductive since it comes to generating theory.

The case presented in this article is an educational program called "School Detectives: The Mystery of the Stone Lion", whose scope is of a *generic-instrumental type* because it tries to illustrate

about a set of propositions the operation of collaborative methodologies in the classroom to generate theory; the nature of the case makes it belong to the so-called *exemplary type*, because the case is presented as an illustrative example of an experience; based on the type of event it is *synchronous or contemporary* because the analysis of the phenomenon takes place at the time the research is conducted; based on the use of a case study it is *exploratory and analytical* because it seeks to describe the program by looking for correlates and effects to enrich educational theories. In the next sections, the case will be described according to the following scheme: a) presentation of the case: objectives, content and competences worked; b) space and resources; and, c) temporal sequencing of the case (summary of proceedings).

2.1. Case presentation: objectives, content and skills worked

In this project three teachers are involved, two tutors and the ICT support teacher, together with the students of a class of 5th Primary grade. The group-class has 19 students (9 boys and 10 girls; one student with educational needs (with educational compensation needs). It is unknown whether or not these students are readers, but what is certain is that the media through which they will access books in the future will be digital. With this work it is intended that, through reading the book "The mystery of the stone lion", students take the extra motivation for them that handling a "device" means. In this way, the process encourages their taste for reading. If we add a plot of mystery and the possibility of using tablets for a research project in a group to these premises, we have all the necessary ingredients to start the process with a high degree of motivation towards the task. Before starting the project, the teacher in charge clearly explains and establishes the work phases thereof:

– What do we want to perform, find, accomplish? Through reading the book "The Mystery of the stone lion" we want to promote basic skills and value teamwork.
– Working phases:
♣ Before reading the book: (i) in the classroom or in the school library: a) Investigate Granada and its neighborhoods, the coexistence between Christians and Arabs, the Alhambra, biography of Ibn Zamrak, Manuel de Falla, Carlos V and Federico García Lorca; interview the bookseller and his work; b) reading "Tales of the Alhambra"; and, c) Knowing some legends (Boabdil, Patio de Los Leones, Abencerrajes …); (ii) ICT: a) PowerPoint + Virtual Class + Presentation on Interactive Digital Board about Granada, the Alhambra; b) Design a comic strip using Ipad, and a Movie with i-movie.
♣ From each chapter: (i) in the classroom or in the school library: a) written essay from the title of each chapter making up a story, plans or sketches, cards, inventing stories of the Alhambra, description of characters, places, creative cooking, great dictionary, riddles, poems, couplets, invent another end, language games (cabalistic, hieroglyphics, secret messages …), b) Arts and Crafts skills: mathematical symmetries; (ii) ICT: reading class in digital format (Ipad), PowerPoint + Glosster detective ID, detective agency certification, treasure hunt, virtual reality, Bingo-book, digital flipping-book, Blog: we spread our work "Detectives at 'Almanzor' School".

In sum, the project entails: (i) the group reading a book in the school library or class; (ii) the formation of groups (detective agencies) that will have to solve the tasks, mostly dealing with research or written or audiovisual expression; and (iii) the selection of the materials posted on the project's blog.

The case study has focused on the learning acquired in Spanish

Language and Literature, Environmental Science and Artistic Education which are not independent but complementary and are enriched when they are worked in an interdisciplinary way and when put into practice through a collaborative participation where students have to make an effort to achieve such significant curricular aspects as searching and selecting information stored in digital format, preparing documents and papers, incorporating their own productions, presenting and disseminating them through different channels, assuming different roles within the group and assessing the importance of taking responsibility for the results obtained by the group.

The project gives great importance to collaborative work through ICT, so that this competence plays a special role compared to the rest of competences worked, namely: competence on linguistic communication, competence on learning to learn, cultural and artistic competition, and with a lower relevance, mathematical competence, competence in knowledge and interaction with the physical world, social and civic competence and autonomy and personal initiative. This is due to the fact that it seeks to develop children skills, strategies and attitudes that enable them to experience reading in digital media, consolidating basic operating procedures of a digital reader (opening of an e-book, navigation index …), using communication tools in a Virtual Classroom (mail, exchange information …), strengthening the use of applications (Word, PowerPoint, Paint.net), using digital tablets (operating system, camera, video), exploring the possibilities offered by some apps for content production (i-movie to edit videos Strip Desing for comics, Qr-Scanner and activities Layar for virtual reality) and starting to use the blog as a tool for publication and dissemination of school work.

2.2. Spaces and resources used in the case study

Most activities were carried out in regular classrooms and groups in the school library. Each class had a weekly session in their classroom, which was equipped with working and consultation areas and the audiovisual equipment and ICT needed. In some of the activities, other spaces of the school were also used. In the search for clues game: corridors, patios and other classrooms were also working spaces. To scan and convert documents use was also made of the photocopier (reprographic room and equipment) and the management office (children worked there in groups).

To carry out these tasks, the ordinary equipment in the classroom was used, including a laptop for the teacher, the digital board and mini-laptops for students. Each student had his/her assigned device throughout the course and used it in class and for homework assignments, sometimes also taking it home. The teams had all the software that they would need installed in their devices: Word, PowerPoint, Paint.Net and Chrome. In addition, for this project we had 20 Kindle digital readers that could be used in class or at the library. However, it was their first contact with the 7 Ipads available at school. Some applications were bought to carry out this project (Strip-Designer, Layar, iMovie and QR code reader for tablets). For some activities, the computer at the head teacher's office was used because it was the only one which had some programs installed, such as the software needed to convert the tasks into flipping-books. As for structural resources, the Virtual Classroom of each class was used, students had been working with it since they were in 3rd grade of Primary Education, and perfectly mastered its access system and operation. A blog for the project was created, and this was their first contact with this tool.

2.3. Temporal sequencing in the case. Actions' synthesis

By reading the book "The Mystery of stone lion", the teachers

involved sought to prepare children to become volunteer readers, not reading compulsorily and taking advantage of the extra motivation that handling a "device" means in order to encourage children to achieve the taste for reading. If we add to all these ingredients one more element as it is the mystery and the possibility of using the tablets to make a group research project, the possibility of obtaining a satisfactory result is greatly increased. The experience takes place in a long time sequence (5 teaching units for 3 months). It occupies the sessions devoted to the Reader Plan (1 weekly hour) and a weekly session which was specifically allocated for ICT competence. The proposal, as shown in this article, is not an isolated entity, disconnected from the rest of the work in the classroom contents, as the contents were carefully selected to cover the corresponding part of reading and writing skills of the teaching units in the area of Spanish Language and Literature and to work specific contents in the area of Natural and Social Sciences, Mathematics and Arts and Crafts.

In this project many activities have been carried out, including searching on the internet the definition of legend, drawing up a Word document with the definition and an example, performing a digital mural (Glogster) and a Blog of the project, crop, scan and post entries on the blog, create a tourist brochure about Granada and the Alhambra using PowerPoint, draw a comic strip with Strip-Designer application or a video on i-Movie, generate their own "detective card" from a template they receive in their email in the virtual platform, using PowerPoint and Paint. To accomplish this task, they have to take a picture with their webcam and trim it to afterwards generate their first QR code and send it by internal mail to finally receive their printed and laminated copy.

Another significant activity was the so-called "treasure hunt" in which the students had to demonstrate the skills they had acquired as detectives. Each agency (group) should succeed in the highest number of tests to get their diploma with the highest level possible. This could only be achieved if there was a real collaborative work among the team members. Departing from the school library, groups had to move along the school trying to get the pieces for the mosaic that they had to generate, only achieved if they underwent all tasks proposed. They prepared the eight tests they had to do with the different contents worked in different areas. Among the tests were games of Language, Maths and Arts and Crafts. In several tests, the children had to demonstrate their digital competence in the use of tablets using Apps for communication, geolocation and virtual reality. Within each group, different members were assigned different roles and each of them assumed a specific responsibility (one was the scribe, another in charge of delivering the results of each test, another was responsible for the transfer of the Ipad, etc.). In addition to the knowledge acquired during the experience and while reading the book (Granada, the Alhambra, authors …), during the children should demonstrate their skill in deciphering codes, problem solving and managing applications consultation, navigation and virtual reality during the task.

Among other things, children must be able to: (i) locate the tracks at the school and decrypt the message based on the 7 gates of the Alhambra; (ii) find a QR code, follow the link to an online questionnaire, fill it in using the Ipad, send their outcomes and go to the library computer to check the result; (iii) solve mathematical riddles; (iv) be able to locate a place at school following clues that contain a symmetry and use Layar to discover a virtual video-track in that place; (v) take a picture under the conditions of marked symmetry and send it through iMessage; and (vi) locate places at school using a map from Google Maps.

In short, all activities proposed involve tasks set for students to boost coordination, sharing computational work, reaching a consensus on the answers, performing inductive and deductive processes, respecting each other, communicating, reaching

agreements and taking responsibility.

Finally, strategic or technical dimension is based on the fact that departing from the methodical decision, the researcher selects the techniques or strategies for data collection that best suits his/her claims. Techniques and strategies which are relevant to the objectives, consistent with the methodological options that are chosen and methodical decisions taken. The techniques and procedures of data analysis can not be considered exclusive to a specific methodology, therefore, in the case presented, participant observation was used, carried out by researchers to gather information about what was happening in the context of the classroom throughout the development of the educational experience, a questionnaire for the teachers involved and the ICT teacher support; and a questionnaire and semantic differential for participating students.

3. Results

3.1. Teachers' and ICT support teacher's valuation of the project

According to data collected both in the tracking sheets and in the interviews conducted, the project has been assessed very positively by teachers and the ICT support teacher.

When teachers evaluate themselves, they state that they feel quite satisfied with the work done. They also manifest that they are highly motivated and very satisfied with the results of the tasks performed. In the following graphics that show the analysis of variance made between the questionnaire items and the time when the experience was carried out, a positive evaluation during the implementation of the program (graphic selected $p < 0.05$) (see Appendix Fig. $A_1 - A_8$) can be perceived.

Students, according to teachers, have achieved the objectives set, have developed the necessary teaching units for its implementation and have worked and assimilated the contents. The methodology has allowed them to work the contents adequately and they consider it motivating. Topics dealt with have turned out interesting for students, as the project has promoted active and collaborative student work and creativity. Both teachers involved and the school head teacher agree that planning, implementation and evaluation of the task take a lot of effort and time.

Selected and processed materials generally have also been rated very positively, noting that have proven useful in the development of theoretical and exhibitions for collaborative work; further highlight that technological resources have also been useful. It has used a wide range of both analogue materials (reading books and notebooks classroom) and digital (interactive whiteboard, tablet, iPad, SmarTable, Kindle).

They also claim that the organization of space, time and type of grouping which were selected have been very appropriate. Groupings have almost always been done with the class group, which has allowed to collaborate with others for entertainment activities, games at school or outside it, and to build camaraderie and teamwork. The richness of interactions generated by these methodologies is reiterated.

Teachers agree on their opinions, highlighting strengths that have contributed to success. Some of these advantages have already been highlighted by other authors such as García-Valcárcel (2015), among others: (i) promotes teamwork and knowledge building in groups makes students more motivated to learn; (Ii) students have enjoyed this type of methodology. It has enabled them to communicate and share via Internet, with email, through the creation of blogs, resolution of geolocalization tracks, among others, what motivated them and called their attention; (Iii) emphasizes the development of digital competition by using different applications as a very motivating element for pupils; (Iv) the positive assessment of the time spent on the project, although it has of course meant greater dedication; (V) both more promising students as well as those with more difficulties have worked very well, very motivated, positively impacting when studying or working with contents; (Vi) the student has developed a high degree of positive attitudes toward peers, the learning process and teachers; and (vii) students are more motivated and has strengthened their self-determination and empowerment.

Among the disadvantages or limitations involved this methodology, teachers have expressed some, which are set out below, coinciding to a great extent with those reported by García-Valcárcel, Basilotta, and López (2014 and García-Valcárcel, 2015): (i) working collaboratively means an added work and overexertion for teachers. They require training to achieve competency in handling with specific tools and developing creativity and own classroom materials; (ii) the complexity of adjusting the time to the project and to each of the activities; (iii) much time is wasted in organizing and grouping students; (iv) insecurity of teachers to the integration of ICT in the classroom as typically appear technical and technological problems; and (v) concern to integrate new assessment methodologies when educational administration still requires performance rates of students with quantitative data and neglect qualitative assessments such as those shown in this study.

3.2. Students' valuation of the project

The assessment of the project by the students was carried out by a semantic differential which was part, together with another series of items, of an online questionnaire. In it, students had to choose a score in an open scale from 1 to 7, depending on whether their opinion was closer to any of the two ends (see Table 1).

As shown in the table above, we can generally say that students value very positively the project carried out, since most of mean scores are between 6 and 7 which are the maximum scores in the semantic positive end. Specifically, the following assessments can be made: (i) students believe that the project has been interesting, funny, useful, and have positively used the time devoted to it (means located between 6.38 and 6.66); (ii) likewise, students claim to have understood the activity, have been concentrated in it, have learned more than other times, and are delighted with this way of working collaboratively using ICT (means between 6.38 and 6.61); (iii) students also think they have shared materials among peers; whom they have also been comfortable with, and now find it easier to relate to them; they consider that the size of the group has been adequate; and that working in group they have successfully managed to do the job (averages between 6.55 and 6.83); (iv) with respect to their teachers, believe that they have helped them, have clearly explained what they had to do, have told them if they did well the duties and told them what was a good or a bad job (means between 6.16 and 6.83); and (v) Finally, note that the average scores are maintained in these intervals that have been pointed out as well as in the statements in which they had to assess the degree to which: they have created and shared information (6.66) have read a lot (6.61), has been interesting and want to learn more about the subject (6.5) and has been helpful to learn through collaborative projects with ICT (6.72).

Finally, the assessment gathers information about what students liked more, which less, and the main problems they found. With regard to what they liked most, students declared that it has been drawing; placing special attention on the fact that almost all children consider that they liked everything that was done and worked and have not found any problem in executing the tasks requested by the teacher. Students tend to show a high degree of motivation and satisfaction with work and collaborative learning with ICT carried out (6.72).

Table 1
Average punctuations obtained by means of the semantic differential.

Semantic differential (1–7) N Valid = 19 N Lost = 0	Media	
It was boring	**6,44**	It's been funny
I lost time	**6,66**	I used the time in a positive way
I have learned fewer things than other times	**6,38**	I learned more things than other times
I read less than usual	**6,61**	I read a lot
It was not interesting	**6,5**	It was interesting
I have not understood what we've done	**6,61**	I correctly understood the activity
I got distracted	**6,55**	I was concentrated
I copied and pasted information	**6,66**	I have created and shared information
I am no longer interested in this topic	**6,5**	I want to learn more about the topic
It has been useless	**6,72**	It has been useful
I did not like this way of working at all	**6,55**	I loved this way of working
The teacher has not helped me	**6,16**	The teacher has helped me
The teacher has not given us clear instructions	**6,66**	The teacher has clearly explained to us what we need to do
We have not shared among colleagues materials	**6,61**	We have shared materials among peers
Now I find it difficult to interact with my peers	**6,55**	Now I find it easier to interact with my peers
We have not managed to do the job when working as a group	**6,77**	Working as a group we have managed to do the job
The group size has not been adequate (there was too few or too many homework)	**6,83**	The group size was adequate
I have not been comfortable with my teammates	**6,66**	I've been comfortable with my teammates
The teacher has not been monitoring our work	**6,83**	The teacher has told us if we did well the tasks
The teacher has not told us the quality of the work presented	**6,77**	The teacher told us what was a good or bad job

Mean values are represented in bold.

4. Discussion

The school is characterized, among other things, by the many personal interactions that occur in it: teacher-student, student-student, teacher-teacher, teacher-parents …

Such interactions are critical because both in the learning processes and in the classroom environment, interaction is essential, either between the teacher and students and students with each other. Accordingly, the success of a group depends on the interaction and cooperation or partnership that is established among its members.

The interaction of collaborative and collaborative type is shown as the most effective ones for learning and that is why one of the basic tasks of the teacher is to promote collaborative and collaborative work and social interaction in the classroom, so they must know and use different analysis techniques and group dynamics.

It should be borne in mind that collaborative learning are characterized by a high degree of equality. Mutuality (degree of connection, depth and bidirectional communication exchanges) is variable depending on whether there is a competition between different teams or not, on the existence of a greater or lesser distribution of roles and responsibilities between members. The highest levels of mutuality are therefore given in cases where discussion and joint planning are promoted, sharing of roles and responsibilities is boosted and the division of labor is balanced among members.

In a competitive structure, classroom objectives or goals of the participants are related so that there is a negative correlation between achievements by agents involved. That is to say, a student can reach the goal he/she has set if and only if other students can not reach theirs.

And in an individualistic structure exists no relationship between the achievement of the objectives participants aim to achieve. That a single student achieves or not the target set does not affect the fact that other students reach or not their own so that each student pursues individual results being the results obtained by other group members irrelevant (Coll & Colomina, 1990). As can be seen, each classroom structures, promotes a different kind of interaction between students and projected onto their school learning.

In our research, the results agree with those obtained in the various investigations conducted on the collaborative work through ICT (Beltrán & Pérez, 1985; Iglesias, Sánchez, & Pedrero, 2014; Iglesias & García-Riaza, 2016) where it makes clear that this type of work favors both academic aspects such as aspects of non-academic type.

With respect to the first (academic) there is no doubt that students make better use of the information provided by peers, promote more accurate communication of information, there is an acceptance and willingness to be influenced by the ideas of others, less difficulty communicating and understanding of others, more confidence in their own ideas, more intrinsic motivation, greater perseverance in the goals, increased confidence in expressing their ideas and feelings in class, they pay greater attention to the teacher and increases the level of response from students.

As for the second (non-academic), with the investigation conducted it has been shown that with this type of work we have promoted pro-social behaviors, integration of students with a lower performance level than that in the classroom, a high acceptance and peer support, increased self-esteem, decreasing fear of failure and a positive effect on social relations, prejudice towards certain peers …

Hereafter are presented some quotations extracted from the interview made to teachers who participated in the experiment and which, together with the results presented above, corroborate what has been previously discussed.

Despite the advantages, the educational program also has some drawbacks as there is a unanimous opinion in manifesting the very high number of hours that led them to plan the teaching with this new methodology, they think that it has taken them longer than if they had followed traditional text manuals or guides. As in other experiences with ICT support, assessment models are not adapted to these technological practices, a fact that teachers involved in this project find it difficult to change and unfair to students. Finally, they think that these methods have more advantages than disadvantages although the pace of work of the learners could have slowed down the progress of the classes.

In the case that has been presented, the evaluation has a transverse character and its programming does not include any concrete evaluation process regarding the participating students. However, the evaluation of the experience was indeed expected.

- " … to work in this way is much more motivating and therefore is supposed to greater contribute to the acquisition of competences. And then there are things like personal history work, for example, we will do some work on our grandparents … That does provide".
- "In the children there has been an awakening, another way of doing and in fact, I'm seeing the results now, they feel more self-assured. For example, the day of the closing they had to present and said, "Do you dare you?" "They wanted to read, wanted to participate and they did a great job. So I think that it has given them self-assurance because they came with a very mechanical learning, learned this and that by heart … And then they have seen other ways and gradually are getting into this other way of working."
- "What we have seen has been an enhanced autonomy, learning to learn, computer, increased digital level because they have learned to investigate, to solve their situations …"
- "And that means that those in my class are more independent, more autonomous but maybe they know more the contents in the other group."

- "The problem is that the assessment is not adapted and evaluating group work is very difficult and I think unfair."
- "The main problems I've had are the times. I measure times pretty bad, sometimes things take much longer than we had anticipated. But for these situations I always have an answer. I would not mind leaving things halfway. I start throughout the year with the projects because I just care about the process, not the outcome."
- "The biggest problem is that organizing children costs more. It seems a waste of time, you have that feeling. Then you see that is not a waste of time because for every step you take you gain time."
- And then the question arises whether the computer is not working or not, some children's were not, or got stuck, 'Please, come here!' … Mostly technical and technological issues."

Regarding the first aspect, it is clear that its development has contributed to the acquisition of the contents of the different areas. In fact, some of those contents programmed in each teaching unit have been worked during the development of the experience. However, none of the courses has been replaced in whole or in part, neither models of common evaluation or qualification, and there was not a special emphasis on the results of the activities carried out. As the school 'Almanzor' has two groups of the same level, one of the operating agreements that have instituted is that the assessment tests should be coordinated and the so must also be the qualifying criteria, setting the percentage of weight of the various assessment tools, among which the written tests tend to have the highest percentage. This does not have to entail any problem when the test is formulated by competences. But often, the tests are based primarily on the textbook and a basic "competence" is to complete blanks or answer questions. This is not the case of this particular course, but that fact is fairly widespread and cannot be ignored.

In regards to the development of the experience, it is not difficult to say that the teachers of the participating groups do not need too many tests to know the students' reading level or difficulties with written expression. It is a matter of changing the methodology and resources, but almost always we forget something important: to intervene in the evaluation process. However, we can say almost categorically that the experience has indeed influenced very positively in improving student outcomes and the acquisition of basic skills. The analysis of the results of the evaluation shows that the participating classes have improved their results in Language and

Environmental Science from previous courses. Obviously, there are many factors involved in the assessment, but it can be concluded that in the worst of the cases, the use of this type of methodology does not adversely affect the results of the students but, in most cases, it is an improvement factor.

As noted, the evaluation of the experience itself was planned in the educational programming, with the instruments referred to in it, observing the process by the participants themselves or by external agents and carrying out a later analysis of the materials generated. The case involved the development and creation of digital materials. Their quality is also a measure of the process. From the evaluation questionnaires and analysis of materials, the general conclusion is that the experience has been very positive and has fulfilled to a high degree the objectives sought. In this evaluation, we can see, once again, that the results are very satisfactory and have greatly helped to achieve all objectives.
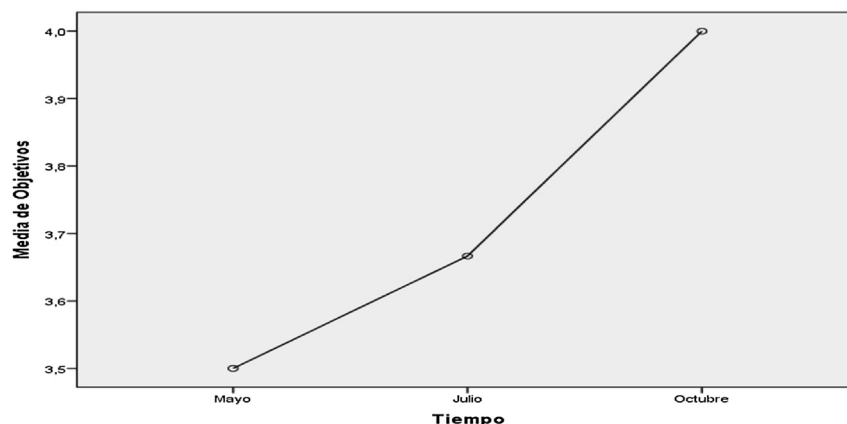
Acknowledgements

Appendix
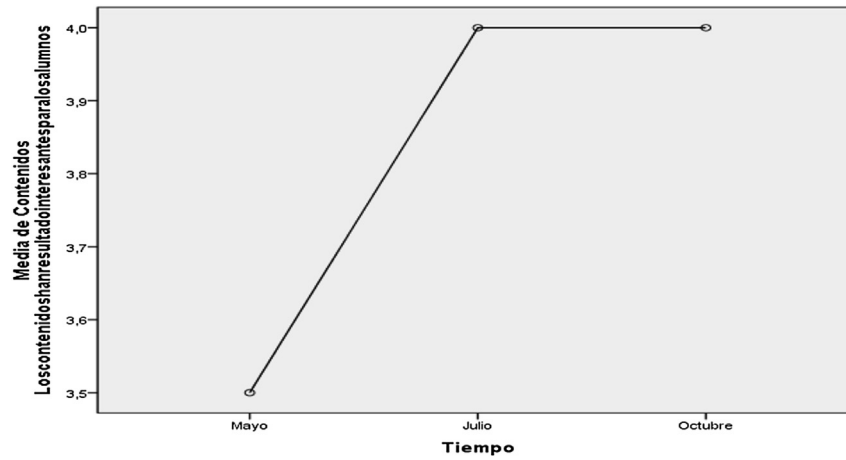

Fig. A.1. Objectives mean.
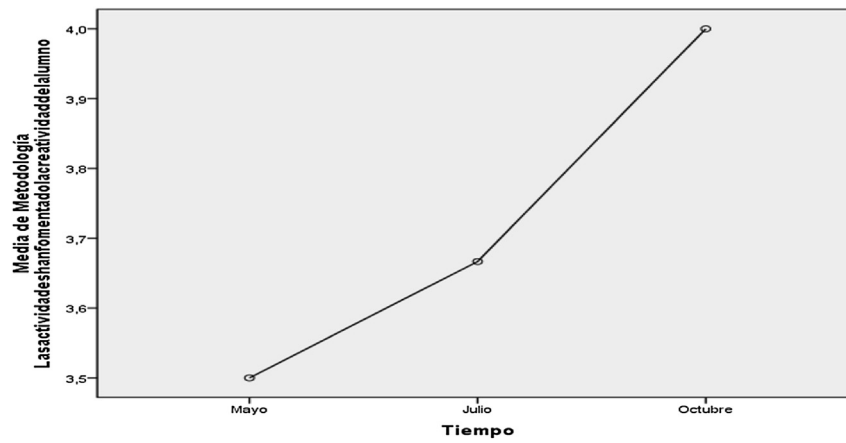
Fig. A.2. Contents mean.

Fig. A.3. Methodology mean: "Activities have boosted students' creativity".
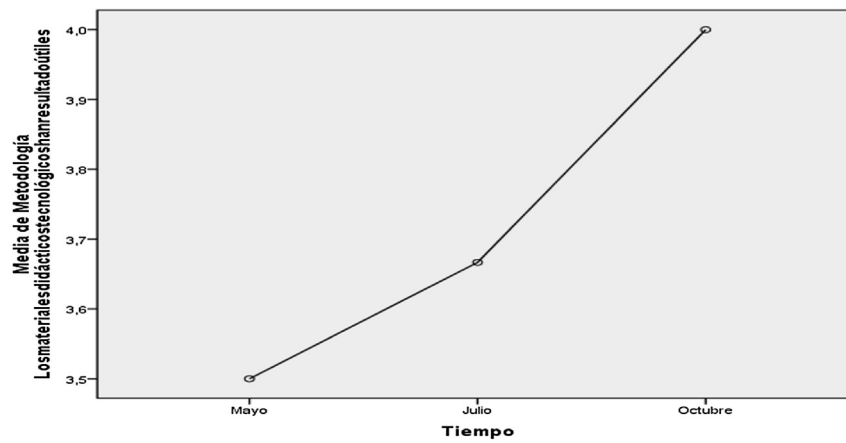

Fig. A.4. Methodology mean: "Didactic technological materials have been useful".
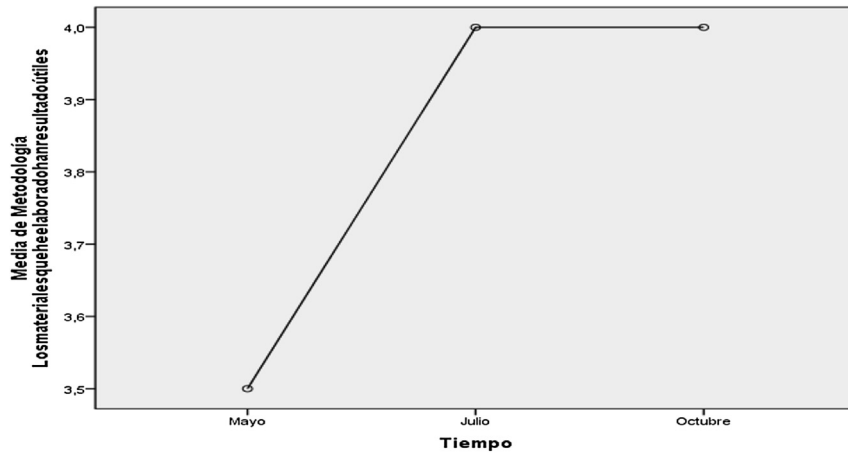
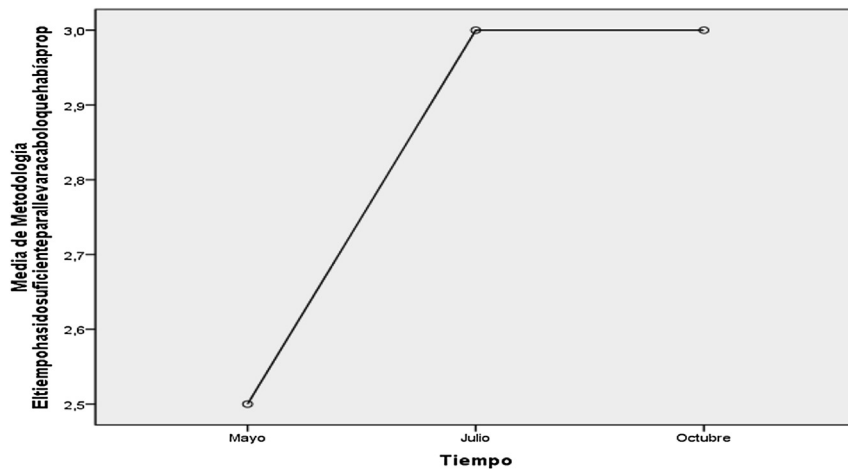**Fig. A.5.** Methodology mean: "Materials I have designed have been useful".

Fig. A.6. Methodology mean: "the time devoted has been adequate to carry out what was initially set".
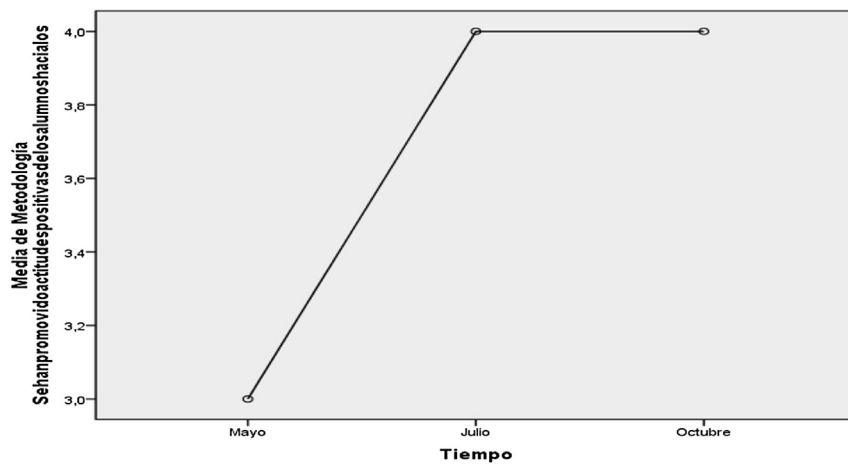

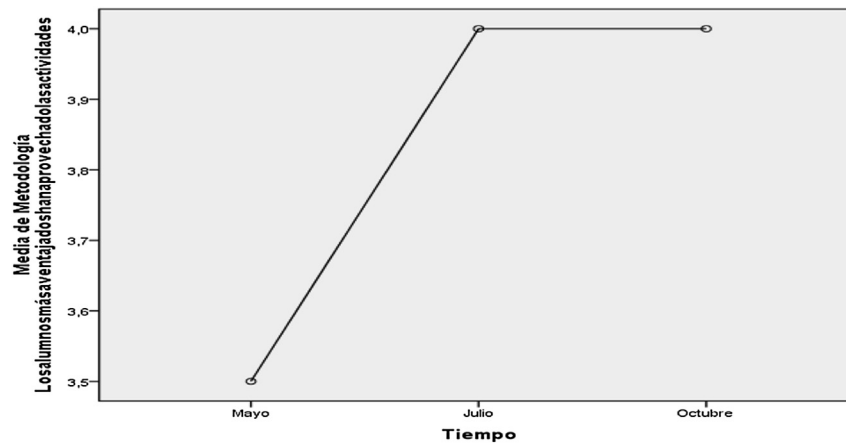**Fig. A.7.** Methodology mean: "Positive attitudes have been promoted among students".

Fig. A.8. Methodology mean: "Students with a higher level have been benefitted by the activities".

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