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Blended learning supported by digital technology and competency-based medical education: a case study of the social medicine course at the Universidad de los Andes, Colombia

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Abstract

Blended courses supported by digital technology (bLearning) and competency-based medical education can be found in different university curricular reform initiatives around the world. Today, it is essential to implement new technologies and teaching methods that are flexible and encourage students to acquire the necessary professional skills.

This article describes how using the bLearning format transformed the Social Medicine course for second-year medical students at Universidad de los Andes (Colombia), particularly their ability to achieve target competencies. A qualitative case study was carried out to explore the curriculum structure, training and skills, educational model and learning environments used during the course. We discuss the methods used, the results achieved, and the challenges encountered during the implementation process.

Findings show that bLearning both facilitated the transformation of the course design and promoted flexibility and autonomy in students' learning process. Additionally, the new format facilitated the development of various competencies including: cognitive, technical and procedural, integrative and communicative, reflection, and professional ones.

Keywords: Blended learning, Competency-based medical education, Project-based learning, Social medicine

Introduction

Blended Learning (bLearning) supported by digital technology and competence-based medical education (CBME) are transforming professional education in the 21st century. Several publications discuss the possibilities and challenges associated with this trend. They show the usefulness of bLearning in making learning more meaningful both at the personal level and at the social level (Hew & Cheung, 2014; Prat-Corominas, Palés-Argullós, Nolla-Domejó, Oriol-Bosch, & Gual, 2010).

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Information and communication technologies allow for relatively easy access to knowledge in a variety of areas outside of educational institutions (Castells, 2006; Martín-Barbero, 2002). For higher education institutions in particular, the use of this modality provides an opportunity to transform pedagogical approaches, thus allowing students to create knowledge in collaboration with others (Hopenhayn, 2003; Márquez & Jiménez-Rodrigo, 2014) and to understand how to use information in a specific context. Additionally, this creates the need for more flexible learning environments that allow people to acquire knowledge anywhere, anytime, and at their own pace. bLearning, understood as a mixture of face-to-face and distance learning, has become an answer to this need, because it combines and integrates the best strategies of each modality (Galvis & Pedraza, 2013).

Numerous cases suggest the benefits of the bLearning modality and the possibilities it offers to boost the development of skills in different disciplines. Sánchez (2015) describes various cases across disciplines in which students from different areas (communication sciences, graphic design, public relations and advertising) who were taking part in a bLearning course were tracked throughout their learning processes. Another study by Aguado, Arranz, Valera-Rubio, and Marín-Torres (2011) describes a program based on this approach which was designed for a group of professionals from a company belonging to the electricity sector.

The CBME approach promotes both individual and collaborative knowledge creation thus allowing students to integrate information that will be used in different contexts and experience learning as meaningful. Both of the aforementioned are key aspects of the constructivist paradigm (Prat-Corominas et al., 2010). In other words, this model promotes situated and contextualized learning which prepares students for real life issues consequently acquiring the professional skills that are the goal of CBME (Trujillo & Zambrano, 2015). Additionally, CBME assessment seeks a more complete and authentic approach to evaluating the student's performance; it applies different strategies and assessment tools that facilitate the observation of student achievement on the proposed professional competencies (Pinilla-Roa, 2013).

Although there are several approximations to the implications of CBME, Frank et al. (2010) summarize the principal ideas. CBME has: 1. a curricular structure focusing on outcomes, and measureable skills and development of competencies through the use of clear evaluation criteria; 2. a learner-centered process which places emphasizes on the needs of society and the student's context; 3. a concern for individual differences of the learner, especially allowing the student to learn at his or her own pace, hence fostering an individual learning process.

With regard to the development of competencies, it has been found that developing competencies is more difficult in completely virtual settings than in blended ones. Through reading or participating in forums exclusively fewer people can develop skills such as negotiation techniques or leadership proficiencies (Aguado et al., 2011). As a result, bLearning modalities allow for the combination of online methods with face-to-face learning which boost the development of target competencies. As is described by Turpo (2012), p. 129, "in operational terms, bLearning includes online activities in both its instructional design and in its face-to-face activities both of which are structured pedagogically such that competencies/objectives are achieved" (author translation).

These changes in educational and research perspectives have shown that physicians trained under the CBME model have performed better in a globalized world (Frank et al.,

2010; Palés-Argullós, Nolla-Domenjó, Oriol-Bosch, & Gual, 2010). Therefore, different resources have been allocated to transform the curriculum designs in medical education.

The purpose of this study was to explore the way in which the transformation of the Social Medicine course to a bLearning modality impacted the achievement of target skills in second year medicine students from the Universidad de los Andes (Colombia). The pedagogical transformation and the course learning outcomes will be described in the next sections.

The transformation of the social medicine course: bLearning and competence-based learning

The course considered for this study was mainly organized around lecture classes in which students were guided through the essential concepts about health, health promotion, disease prevention, and predictors for disease. The revision of the course syllabus emerged from the instructor's pedagogical reflection about her conceptions and educational practices. This reflection, which was both an individual and collaborative process, was crucial for the improvement of educational practices. The reason for this is that a reflective practice leads the instructor to transform their daily practices and therefore modify students' learning (Gómez, Ternent de Samper, Alba, & Ghitis, 2013).

Initially, we decided to review the course program beginning with the analysis of the core competencies we planned to foster in the students. The methodology and approaches to assessment were adjusted in keeping with the curriculum alignment proposed by Biggs (2006). Later on, the virtual and face-to-face settings were decided upon and a course which promoted autonomy and collaborative work was created. Fourteen face-to-face sessions that lasted two hours each were designed. The course's key concepts were addressed through workshops, discussion panels with experts, interventions in educational institutions and final papers. Throughout the course, ten two-hour virtual sessions were implemented as well. In these virtual sessions, students completed different tasks that reinforced face-to-face session outcomes. These included videos and readings from visiting professors and student participation in a Wiki, where they displayed their learning using the thinking routine connect-expand-challenge on the reviewed materials (Krechevsky, 2012). It is important to note that students also used the Wiki to construct their project and to carry out the self and peer evaluation of their group work.

At a second stage of the implementation, the design was carried out for one semester. Using different methodological strategies, an evaluation process was conducted. Before participating, participants signed an informed consent. The information gathered led to a new adjustment of the program, the face-to-face and online spaces, and also of the digital platform design. This was done with the objective of improving the course's learning atmosphere and, in consequence, the students' learning processes.

It is important to note that the use of Blackboard®, the virtual platform in which this course is based, changed significantly. Before the pedagogical transformation, it served only as a repository for different readings, to publish assignments, show grades to students and facilitate email exchange between the instructors and the teaching assistants. Thanks to the new design, available Web 2.0 tools were put into use, especially Wikis and teamwork dynamics. This led to better interaction with the available resources and

the creation of collaborative work dynamics among students. Communication between students and the team of instructors and teacher's assistants also improved.

Today the course aims at developing four competencies in second-year medicine students (Table 1), and this is accomplished through their participation within two specific projects. In these projects, they have contact with different health problems and risky scenarios in individual, family and community contexts. The methodology used is called Problem-Based Learning Organized by Projects (PBL-OP).

The first project consisted in creating an intervention focusing on the promotion of mental health for students from different programs at the Universidad de los Andes. The impetus for this particular intervention was based on a study of social determinants of health and issues that had been prioritized by the Dean of Students and the student body of the university. The second intervention project was based on a case study of a student with learning disabilities at a public high-school in Bogotá. In this case, the ecological model was used on the basis of which the students' health status could be analyzed. Taking it from there a feasible proposal to both school and families could be developed to improve the students' well-being.

Finally, assessment processes revealed what students had learned in the course and permitted us to monitor the achievement of the target competencies. Assessments were conducted individually and collectively both online and face-to-face throughout the project phase of the course. Each time the students submitted their work, they were provided with an assessment rubric that included specific scoring criteria based on the learning objectives (Tables 2 and 3). The use of these assessment tools led to the early detection of students with low academic performance, which in turn, allowed us to give them timely, appropriate guidance to help them acquire the competencies proposed for the course.

Methodology

The objective of this study is to explore the way the transformation of the Social Medicine course using the bLearning modality helped second-year medicine students of Universidad de los Andes acquire a series of target competencies. A qualitative case study which explored students' academic transformation and outcomes was conducted (Stake, 2007). According to Stake (2007) and Yin (2009), case studies can provide the researchers with both the uniqueness and complexity of a particular case, thus allowing them to acknowledge the diverse perspectives of those involved in this transformation process.

This research was conducted during the first semester of 2015. It drew on three sources of information. First, the key documents of the course were examined (course program, final papers and students' reflections). Second, semi-structured interviews

Table 1 Competencies in the Social Medicine course in the first semester of 2015

1. Acquires basic knowledge related to the concepts of health prevention and health promotion and applies them to the project proposals.

2. Understands the models for approaching the health-disease process, such as the social determinants of health and the ecological model, which are generated from the interaction between the individual, the family, the community. Also understands the risk factors and the protective factors present in these processes.

3. Knows and applies basic concepts of qualitative research as well as psychosocial screening tools used in the holistic approach to individuals.

4. Understands the importance of and reflects about the professional values implicit in team work and in health care in communities. Actions reflect respect for the others.

Table 2 Assessment rubric for "Health-Promoting University" project

Assessment criteria	Percentage	Score				
		5.0	4.0	3.0	2.0	1.0
Describes and analyzes the case-problem using the principles of the social determinants of health model.	25 %					
Appropriately uses the principles of qualitative research to understand and analyze the problem of the assigned case.	20 %					
Formulates a plausible and creative health promotion and disease prevention strategy in accordance with the problem of the assigned case.	25 %					
Adequately references the sources used in the paper.	15 %					
Writing, grammar and spelling fulfill the expectations for academic compositions at the university level.	15 %					

were designed and carried out with two students, two teaching assistants and two instructors. Focus groups were conducted with three teaching assistants and two groups of four students. Finally, to complement the aforementioned data, an online survey was applied. It was completed by 83 % of the students at the beginning of the semester and by 40 % at the end of the semester. The information gathered through the document analysis and the qualitative methods was transcribed and coded using the categories described below. The categories were created to analyze the curricular structure, the training process, the skills acquired by students, the academic model and the learning environments used in the course.

1. Methodology (pedagogical strategies used during the course)
2. Modality (different components that are part of the bLearning modality)
3. Assessment (different tests and evaluation processes conducted during the course)
4. Competencies (components of the CBME)
5. Instructor's role (as a learning guide or as a content provider during the course)
6. Student's role (the students' involvement in the development of the course as an active learner and builder of knowledge or as a passive learner and recipient of knowledge)

To analyze the data, the software ATLAS.ti® Version 7 was used. To analyze and interpret online survey responses, Microsoft Excel® (2013) was used. The data from the different sources was triangulated.

Table 3 Assessment rubric "Learning Disabilities" project

Assessment criteria	Percentage	Score				
		5.0	4.0	3.0	2.0	1.0
Describes the problem appropriately, justifies its relevance and sets clear goals.	20 %					
Formulates a methodology that is coherent with the case and describes it adequately.	20 %					
Analyzes the case using the principles of the ecological model, integrating the information gathered during the process with the bibliographic sources.	20 %					
Proposes health promotion and disease prevention strategies specifically aimed at their assigned case.	20 %					
Adequately references the sources used in the paper.	10 %					
Writing, grammar and spelling fulfill the expectations for academic compositions at the university level.	10 %					

Results and discussion

In this section, we present the results by category and discuss them in the same order. To address the research objective, we place particular emphasis on findings related to assessment and competencies.

Category 1: course methodology

The course methodology allowed students to become the protagonists of their own learning process and to fulfill the course objectives through the following projects: "Health Promoting University" and "Case Study of a Child with Learning Disabilities". Participants highlighted that they became engaged in these projects, not only for academic reasons, but also because it contributed to their professional development. One student commented:

> *Aside from the obvious, like the readings and videos, I believe the strategy that best describes the way I was able to internalize the concepts was the chance to apply them to real life. It's no use reading about the meaning of health determinants, what they are and what they are for, if I can't feel them more tangibly (Student Interview).*

On the other hand, the instructor and the teaching assistants discovered that the implementation of this methodology required them to form teams of students. This meant organizing the teams responsibly by creating team rules, norms for communication and group work, and expectations about solidarity and cooperative leadership so that students could achieve the activities. These characteristics constitute important skills that medicine students must develop within the CBME model (Frank et al., 2010; Prat-Corominas et al., 2010).

Category 2: instructional modality

The use of the bLearning modality helped students to reach their learning objectives. As stated by Galvis and Pedraza (2013), this approach created a more flexible learning environment in which students could learn in their own time and space, and also at their own pace.

Students and teacher's assistants highlight that the online classwork prepared them for the face-to-face sessions and was complementary to their learning process. Among the most useful strategies were collaborative reading and the accessibility of the contents online, both of which made it possible for students to better comprehend key concepts required to develop the course projects:

> *Through the use of the online resources, I could understand the idea of a Health Promoting University. I was able to comprehend the importance of these dynamics in health promotion strategies [...] I understood how these initiatives are crucial in the field of Medicine [...] (Student focus group).*

> *[Students] worked collaboratively online [...] and the face-to-face sessions became so important that it is worth it to attend class (Teacher's assistant interview).*

Data also showed that students experienced difficulties when they were not accustomed to the bLearning modality and its requirements. Another finding related to the use of bLearning is that it improved students' teamwork skills as is shown in the results of the survey in Figs. 1 and 2.
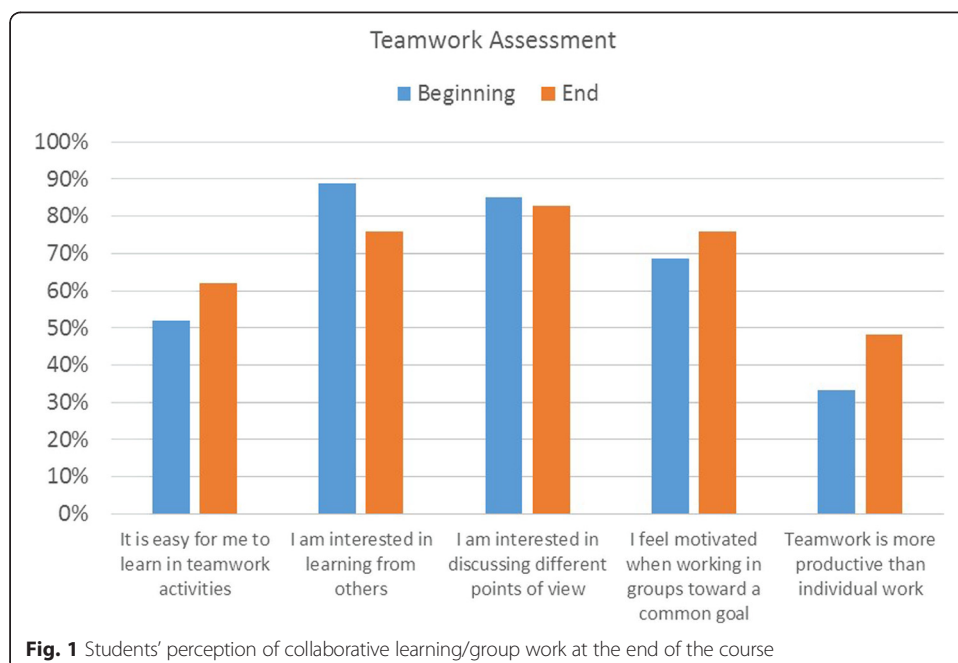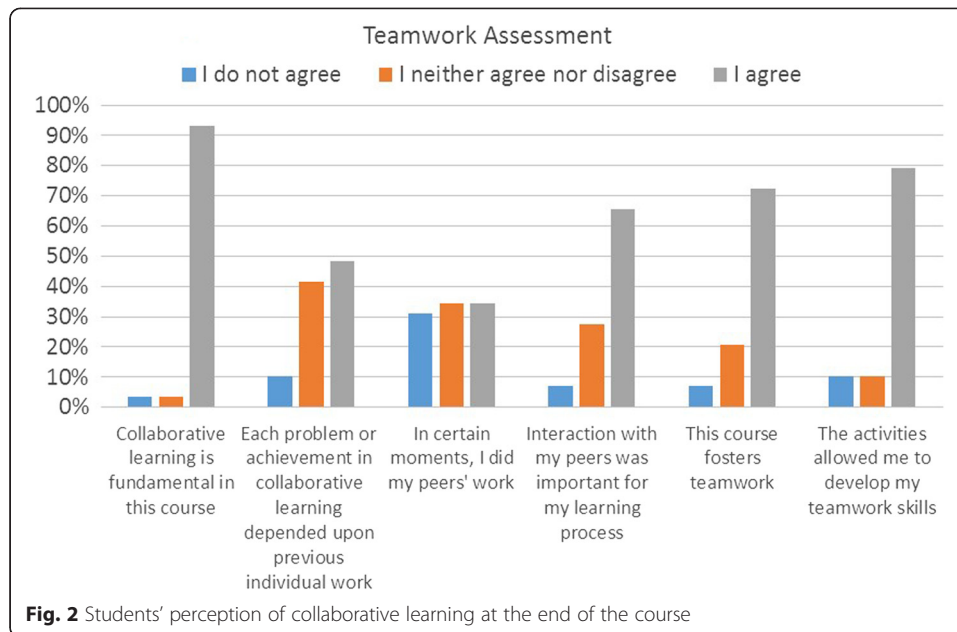
Category 3: assessment

The assessment process in the course was aligned with the objectives and the methodology (Biggs, 2006). Learning outcomes were determined from student projects and formative assessment was used to help students recognize their strengths and weaknesses as they developed course competencies.

I think it's really positive that the students receive feedback more quickly, especially about smaller tasks, because they can monitor their performance and don't have to wait until the end of the course to know what they are doing right or wrong (Teacher's assistant interview).

The written exam [...] is a completely different kind of evaluation from any other one used in the University because it's based on cases [...] so I had to actually apply the concepts that I have been learning (Student interview).

There are many cases in which students do not identify with this methodology. The same thing happens with this new type of evaluation because during students' academic career, they are mostly evaluated using content-based exams. This is the reason why some students and teaching-assistants in this focus group consider non-traditional evaluations to be a weakness, because without traditional content-based exams they feel unable to realize in

Fig. 1 Students' perception of collaborative learning/group work at the end of the course

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Fig. 2 Students' perception of collaborative learning at the end of the course

how far they meet the course objectives with respect to acquired knowledge. Nevertheless, the results of the evaluation processes show clearly that they did allow the students to achieve the target competencies, as shown in the final grades of the course (Fig. 3).

Category 4: competencies

The purpose of transforming the approach to this course was to shift from a content-based learning method to a CBME. This change garnered a positive response from the actors involved in this project as the following quote indicates:

> [...] It's true learning because it transcends theory. This experience made me more human. I managed to feel empathy for the girl, to put myself in her shoes and thanks to this, I gained an understanding that surpasses classes, readings and words (Student's reflection).
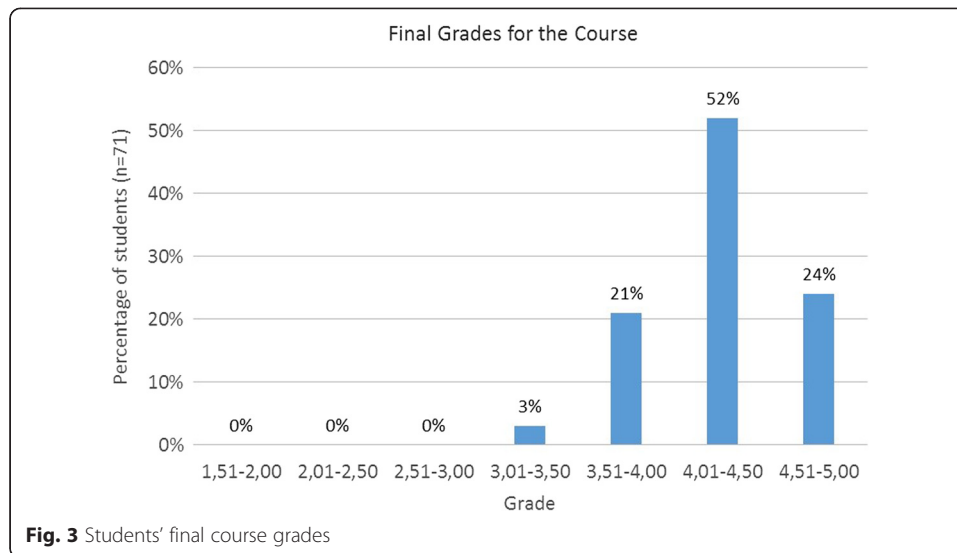
Through a PBL-OP approach, students developed different CBME core skills including cognitive, technical, integrative, contextual, relational, affective and moral competencies (Epstein & Hundert, 2002). One reflection recounts that:

> I understood that there's a direct link between the patient's context and his or her health. This relationship is multifactorial and is constituted by many variables like resources, finances, occupation, psychosocial and cultural environments, to mention a few (Student's reflection).

Furthermore, the data analysis shows that other competencies developed involve students' ability to reflect on their task, their role as physicians and their autonomy.

> It's the first time that they as medical students are faced with a person's problem and that they have to solve it through teamwork. So, they develop new problem-solving

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Fig. 3 Students' final course grades

abilities and new skills to research what they need to do so (Teacher's assistants focus group).

The learning skills achieved in the projects can be observed in Fig. 4. Finally, the survey showed that most of the students believe they acquired the skills proposed in the course syllabus. This perception corresponds with the results of the course evaluation (see Fig. 5).

Category 5: the professor's role
The findings show that for the different parties involved in the Social Medicine course, teachers have a special role that allows them to guide students' learning processes:
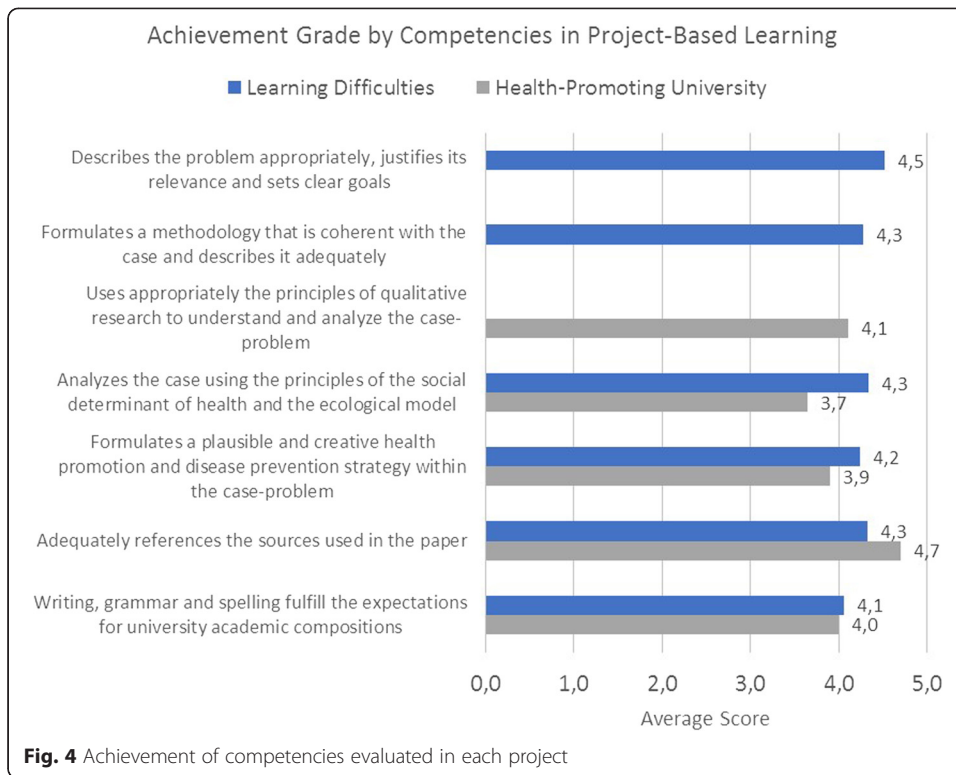
[…] *I think it is respectful to have a role in which I can support them, guide them, and motivate them to learn. The teacher's assistants have also assumed this role* (Professor interview).

Likewise, teaching-assistants played an important role in the development of the course projects due to their support of students in face-to-face and online learning spaces:

[…] *After applying this methodology, now [the course] is more dynamic, though it requires more time because teaching-assistants support the students as they develop their projects and we answer questions in a more consistently and closer way* (Teacher's assistants focus group).

In the end, many of the students claim that they would like to continue to having this is the type of professor in their medical training. One commented that:

I feel very comfortable because this [course] gives us more independence to manage methodologies and time as we do the projects. Since the class focuses on projects, the

Fig. 4 Achievement of competencies evaluated in each project

Fig. 5 Average scores assigned by students at the end of the course evaluating the acquisition of competencies on a Likert scale where 1 means "nothing" and 5 means "a lot"
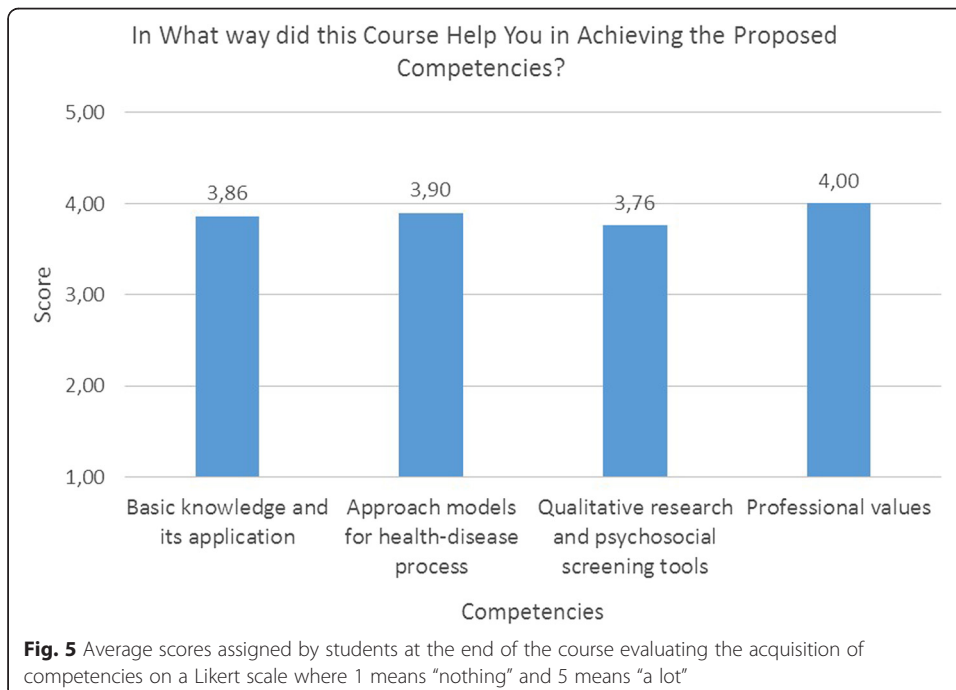
projects are our ideas and they are not really influenced by the professor [...] (Student focus group).

Category 6: student's role

It is possible to confirm that the students' roles have changed with the transformation of the course. The course transformed from one with passive students who were recipients of knowledge, as is typical of traditional teaching models, to one with active students who constructed their own knowledge. This is due to the course's orientation towards the CBME model, the PBL-OP methodology and the use of the bLearning modality (Fig. 6):

I learned a lot from online learning, much more than from face-to-face, because I was completely responsible for my learning process and for being conscious of the objectives of each virtual session (Student's interview).

Conclusions

Based on the results described in the previous section, it is our aim to highlight how the new course design has allowed students to develop the target competencies. These outcomes derive from the alignment between the objectives, the methodology and the assessment (Biggs, 2006). The objectives focus on: the competencies and the PBL-OP methodology combined with the bLearning modality. This particular combination of methodologies conceives of the student as the protagonist and the instructor as a guiding figure who participates actively in the construction of learning.

The student's main role is achieved due to the fact that the PBL-OP approach promoted meaningful learning experiences and also encouraged students to find the course contents meaningful for them (Frank et al., 2010; Prat-Corominas et al., 2010). By the same token, the combination of this methodology with bLearning made it easier for the instructors to monitor their students' learning processes.
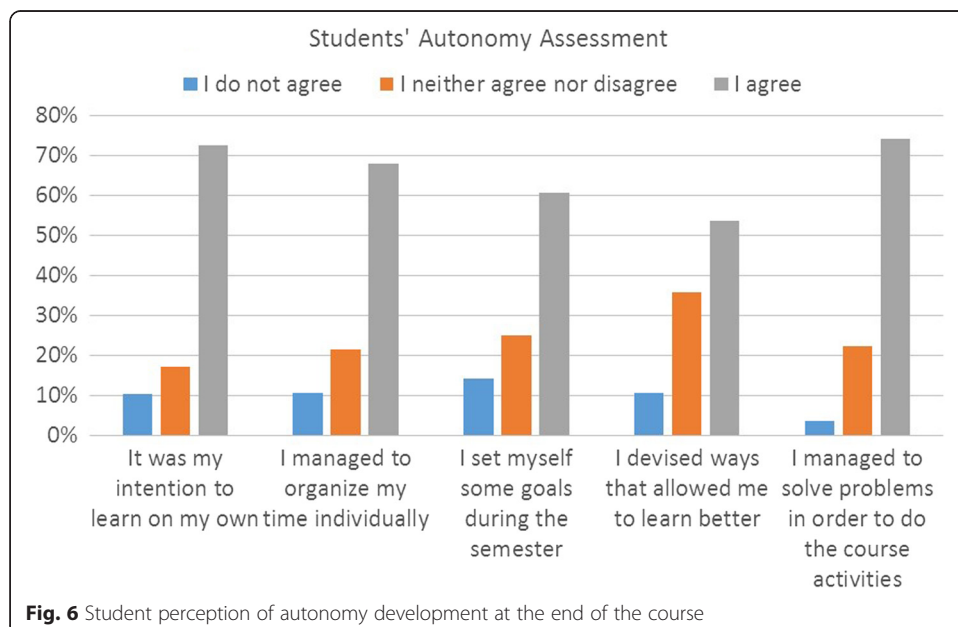
Fig. 6 Student perception of autonomy development at the end of the course

This allowed them to observe their strengths and weaknesses in the development of the course competencies.

The instructor's role in the design of learning environments is just as important as the students' role, as many researchers have suggested (Galvis & Pedraza, 2013; Hew & Cheung, 2014). Considering the new role of the professor in this approach is paramount for the articulation of flexible learning spaces with different resources in both the online and face-to-face settings. Besides this, the instructor facilitates feedback opportunities, which allow students to achieve the target competencies.

We can observe that this model promotes learning for many students whereas for others, it is still a difficult model to understand and cope with. Some students feel more comfortable when they are placed in a passive role. They express a tension between having the instructor as a guide and their wish for the professor to continue being a transmitter of knowledge. However, this changes as the students make their learning visible in the completion of course projects.

In sum, this article describes the opportunities, difficulties, and challenges faced during the curricular implementation of this course. This CBME course using bLearning and PBL-OP shows that it is possible to combine the approaches approximations in different disciplines and learning environments as is shown in the Colombian foreign language learning experience (González-Moreno, 2011; Mendieta-Aguilar, 2012). In similar fashion, these outcomes also arise in the implementation of the Management and Public Administration curriculum as shown by Márquez and Jiménez-Rodrigo (2014).

Finally, the authors of this article believe that these transformations can be achieved in different types of curricula. Yet, whatever the discipline, it is not only a transformation to the methodology and modality that is required: the permanent reflection of the instructor about student learning and educational processes is also fundamental.

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