Using concept mapping for faculty development in the context of pedagogic frailty

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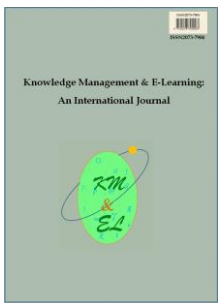

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Abstract: The quality of teaching does not depend exclusively on the knowledge and experience of teachers, but also on the contextual variables that go along with the teaching (attitude, objectives, students, resources, etc.) or dimensions of pedagogic frailty (regulative and instructional discourse, pedagogy and discipline, research teaching nexus and locus of control. Identifying these variables may help to enhance teaching. A procedure for the capture, representation and transfer of knowledge between peers regarding active didactic methodologies supported by Information and Communication Technologies (ICT) was applied in a case study research. The data were represented by concept maps. The aim was to identify variables that affect Technological Pedagogical Content Knowledge (TPACK), the use of technology in teaching and pedagogic frailty, through the analysis of the interrelations among the concept maps.The analysis of the maps shows the implementation of many innovations with ICT (project-based learning, service-learning, collaborative learning), their positive aspects and the difficulties in carrying them out. The teachers involved pointed out some factors that contribute to the development of pedagogic frailty, including the number of students in each class, the organization of teaching, the motivation, among others, and as conditions for a greater progress in innovative educational experiments using ICT.

Keywords: Pedagogic frailty; Concept mapping; Knowledge management; Faculty development; TPACK

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1. Research background

University professors are usually experts in their fields who participate in the academic community, contributing to the development of their area of knowledge at the same time that they work as teachers in it. However, just as they keep abreast of any new developments in their fields, it does become harder for them to address the pedagogical changes imposed by an evolving society, and which would entail new teaching methods (integration of new methodologies, new learning scenarios promoted by technologies, or new resources).

We see the organization of educational processes in these new scenarios, which are created around digital technologies, as a process of teaching innovation based on the creation of the conditions to develop the capacity to learn and adapt in organizations and individuals alike. This perspective allows us to see innovation as a deliberate and planned process based on theory and reflection, and which meets the needs for changing, in the practical aspects, in order to achieve the objectives (Salinas, 2004).

Higher education institutions have experienced a change of certain importance throughout the current society's educational system: educational processes have moved from the conventional scenarios to other environments, there has been a widespread demand for students to be taught the skills needed for lifelong learning and the systematic use of digital technologies. The scope of learning varies dramatically, evolving towards new models that emphasize students' active participation in the learning process. It is generally accepted that the teacher's role changes from one of relaying knowledge to one of helping students to build new knowledge by themselves. However, teachers in general seem to be opposed to engaging in the innovation processes created from these changes, which are mostly pedagogical in nature. In spite of their expertise in the subject matter (content knowledge), they show a lack of expertise in teaching (pedagogical knowledge).

Teachers need a deep understanding of how to teach their subject matter (Pedagogical Content Knowledge/PCK), for an effective practice in diverse, multicultural and inclusive learning environments (Shulman, 1986; 1987; McDiarmid & Clevenger-Bright, 2008; Avidov-Ungar & Eshet-Alkalai, 2014). PCK is linked to student learning. However, academic tend to separate teaching from research in their minds, such that the expert opinion evident in their research is not always present in their teaching discourse (Kinchin, Hatzipanagos, & Turner, 2009). This separation appears in the model of

pedagogical frailty (Kinchin, 2015), when it confronts pedagogy and discipline or research and teaching connections.

Subject knowledge and pedagogical content knowledge integration can help experts to project their personal notions of learning to students so that they can develop expert-like thinking skills themselves. Various studies (e.g. Fullan & Smith, 1999; Kozma, 2003; 2008; Hattie, 2009; Schleicher, 2016) reveal that the integration of changes in teaching methods in general, and in educational technology in particular, can be very complex, and that the teacher's skills, attitudes and beliefs are of paramount importance for success in any radical paradigm change in education.

Authors such as Brush and Saye (2009), or Bull and Bell (2009), emphasize the fact that the effective integration of educational technologies requires teachers to master three types of knowledge: technological knowledge (proficiency to operate the technology), teaching knowledge (mastery of teaching approaches, strategies and theories), and pedagogical content knowledge (mastery of the subject content). The ability to combine these three types of knowledge is critical to the effective integration of Information and Communication Technology (ICT) in teaching. Mishra and Koehler (2006), based on the works of Shulman (1986; 1987), proposed the Technological Pedagogical Content Knowledge (TPACK) as a holistic framework that describes the types of knowledge teachers should master in order to effectively integrate technology in their teaching.

The TPACK's conceptual framework assumes there are three components at the center of good technology-integrated teaching, namely: content, pedagogy and technology, and that effective integration is dependent on how they are interconnected. Thus, TPACK is positioned as the theoretical framework suited to deal with the knowledge integration, and to train and refresh teachers in the use of ICT and new educational environments (Koehler & Mishra, 2008; Mishra & Koehler, 2006). Similarly, the concept of pedagogic frailty (Kinchin, 2015) refers to the connections and conflicts between content and pedagogy and between teaching and practice.

From this perspective, it is a challenge to develop a procedure to capture and transfer ICT expertise acquired by teachers through their experiences (from both personal learning and teaching practice) among their peers; and which drives the intellectual development of university educators in the use of teaching technology (de Benito, Lizana, & Salinas, 2016).

The comprehension of educator skills as "dynamic combinations of cognitive and meta-cognitive skills" suggests four fundamental aspects: learn to think as teacher (it implies a critical examination of one's beliefs and the development of pedagogical thinking), to know (it concerns aspects of knowledge, including the knowledge generated by one's own practices), to feel (intellectual and emotional aspects), and to act as teachers (by integrating thoughts, knowledge and dispositions in practices that are informed by consistent principles) (Feiman-Nemser, 2008). And this, along the same lines as TPACK, deals with the conceptualization of knowledge on the part of the teacher that is based on the teaching experience.

The capacity that teachers have to draw conclusions and make decisions in a collaborative manner, and to collect and analyze evidence (such as students' learning results, or data from internal or external evaluations), is fundamental to the development of a "culture of evidence" in education. This matches the definition of professional teaching by TALIS (Teaching and Learning International Survey), which highlights the teaching knowledge base, peer-to-peer networks and autonomy (Schleicher, 2016).

There is a growing recognition of the benefits where teachers themselves generate new teaching knowledge, in the very center considered as communities of practice and inquiry (Hagger & McIntyre, 2006; Cochran-Smith, Villegas, Abrams, Chavez-Moreno, Mills, & Stern, 2015; Chen, 2017).

Apart from being up-to-date with discoveries in their fields of knowledge, today's educators must also be in tune with the possible teaching/learning innovations, and the prospects created by digital technologies. The educator changes roles when we contemplate teaching from the student's perspective: s/he ceases to be a source of knowledge to become a facilitator who helps students in learning the resources and tools they will need to explore and create new knowledge and skills, and who also becomes the manager of important educational resources, emphasizing his/her role as advisor. Paradoxically, the educator's role in these student-centered methodologies becomes more intricate (Salinas, Perez, & Benito, 2008).

By moving from a transmissive educational system, whose knowledge teaching structure is generally lineal, to one where students engage in critical reflection and knowledge building instead, tends to be a burdensome process for university professors. Linear teaching models do not invite you to engage in reflective practice, nor do they leave space for student/educator development (Kinchin, 2016). In this context, the integration of innovative technologies in such a restrictive model breaks its transforming potential, reducing it to simple utilitarian tasks, and to keeping the status quo of a transmissive teaching model (Kinchin, 2012).

To add conceptual coherence to the reflections on teaching, and to maintain a concurrent focus on key elements of the teaching ecology, Kinchin (2015) has introduced the concept of pedagogic frailty. The reference to the perceived separation between pedagogical knowledge and disciplinary knowledge, the asymmetry between teaching and research can be found among the key dimensions of this model.

Thus, in the context of higher education, one might see a concept of 'pedagogic frailty' where troubled professors find the accrued pressures of the academy (persistent stressors) eventually inhibit their capacity to change and respond to a changing learning environment, leading them to adopt a "safer" and more sustainable pedagogical approach (Canning, 2007).

The overall model proposed for pedagogic frailty concept sums up the connections between key dimensions: the lack of an explicit regulative discourse to promote a shared values literacy; a perceived distinction between teaching and subject; the strain created by the asymmetry between teaching and research; and the distance between teaching practice and the locus of control inside the university (Kinchin, 2015; Kinchin, Alpay, Curtis, Franklin, Rivers, & Winstone, 2016; Kinchin & Winstone, 2017). Although there may be a combination of personal and institutional factors that can lead to pedagogic frailty, it is above all the result of the quality and degree of interaction within and among the aspects of the professional environment (Kinchin et al., 2016).

The new role for educators suggests a series of changes until a model that meets the challenges of the future society is found. To move on from models that depict teaching as a "technical process", and which includes the educator as a mere executor who has to acquire the capacity and skills to raise his/her effectiveness through resources (making use of what is referred to as 'generic' methodologies), to broader models that present teaching as a place of knowledge, learning and socio-political debate, where knowledge is chosen, legitimized and diversely distributed; which presents the educator as a professional qualified to perform as decision maker and judge, able to appraisingly

reconstruct his/her own practice, and to creatively include the means (‘specific’ methodologies) (Salinas, 2004).

The European Trade Union Committee for Education (ETUCE) describes quality teachers as equipped with the ability to integrate knowledge, handle complexity, and adapt to the needs of individual learners as well as groups. Teacher competences are built on 'a concept of teaching as praxis in which theory, practice and the ability to reflect critically on one’s own and others’ practice illuminate each other, rather than on a concept of teaching as the acquisition of technical skills' (ETUCE, 2008).

In order to develop this new role of guide and facilitator, educators need orientation and professional support services so they can fully participate as professionals. Promoting teaching skills recommended by Feiman-Nemser (2008) that suppose learning to think, to know, to feel and to act as teachers, suggests the adoption of new ways of professional development that go beyond the traditional teachers’ qualification channels; promoting participation in the development of teaching knowledge through exchange of teaching practices in peer networks and communities of practice.

On the other hand, the teaching faculty (staff) also need the essential skills to continually innovate and adapt. This includes having critical, evidence-based attitudes, enabling them to respond to students’ outcomes, new evidence from inside and outside the classroom, and professional dialogue, in order to adapt their own practices (European Commission, 2013, p. 7).

2. Methodology

2.1. Research aims

The aim of this study is to apply a procedure for the elicitation, representation and transfer of expert knowledge between peers regarding active didactic methodologies supported by ICT. With this procedure, based in concept mapping, we try to identify the different variables that affect TPACK knowledge, the use of technology in teaching and pedagogical frailty and the interrelations between them.

2.2. Procedure description

In previous studies, a procedure for the elicitation, representation and transfer of expert knowledge in the use of methodologies with ICT in university teaching was developed by the authors, through four case studies involving 20 teachers of different disciplines (Lizana, 2012; de Benito, Lizana, Salinas, & Urbina, 2014; de Benito et al., 2016).

The procedure aims to identify the expert technological pedagogical knowledge, the methodological principles that guide the adequate use of ICT in university teaching, as well as to determine factors related to the strategies of implementation of ICT in teaching, by using valid techniques and instruments that guide the capture and representation of knowledge.

The procedure has been constructed following a design-based research method, i.e., a generic model for conducting design-based research in education as described by McKenney and Reeves (2012, p. 77)

The different cycles allow simultaneous attention both to the development and implementation of innovative experiences in a collaborative way, and the construction of pedagogical knowledge through the exchange of teaching practices in networks of peers and communities of practice.

The procedure was built on studies carried out by Ericsson, Charness, Hoffman, and Feltovich (2006), Coffey, Hoffman, Cañas, and Ford (2002) concerning the use of concept maps to represent the tacit knowledge of experts in different fields and the knowledge transfer model of Liyanage, Elhag, Ballal, and Li (2009), Nonaka and Takeuchi (1995) (see Fig. 1). In this sense, concept maps provide a way to represent knowledge, while allowing users to navigate through the expert knowledge model. Coffey et al. (2002) adopted concept maps as a tool to facilitate the comprehension of the conceptual relations and structure of knowledge. They therefore constitute the tools to represent and publish research models in order to promote the collaboration of other researchers (Cañas, Ford, Coffey, & Breedy, 2000). Knowledge representation finds on concept maps, one of the most used instruments to capture and represent expert knowledge (Leake, Maguitman, Reichherzer, Cañas, Carvhalo, Arguedas, Brenes, & Eskridge, 2003; Cañas & Novak, 2006; Crandall, Klein, & Hoffman, 2006; Kinchin, Streatfield, & Hay, 2010; Alexander, Bresciani, & Eppler, 2015).

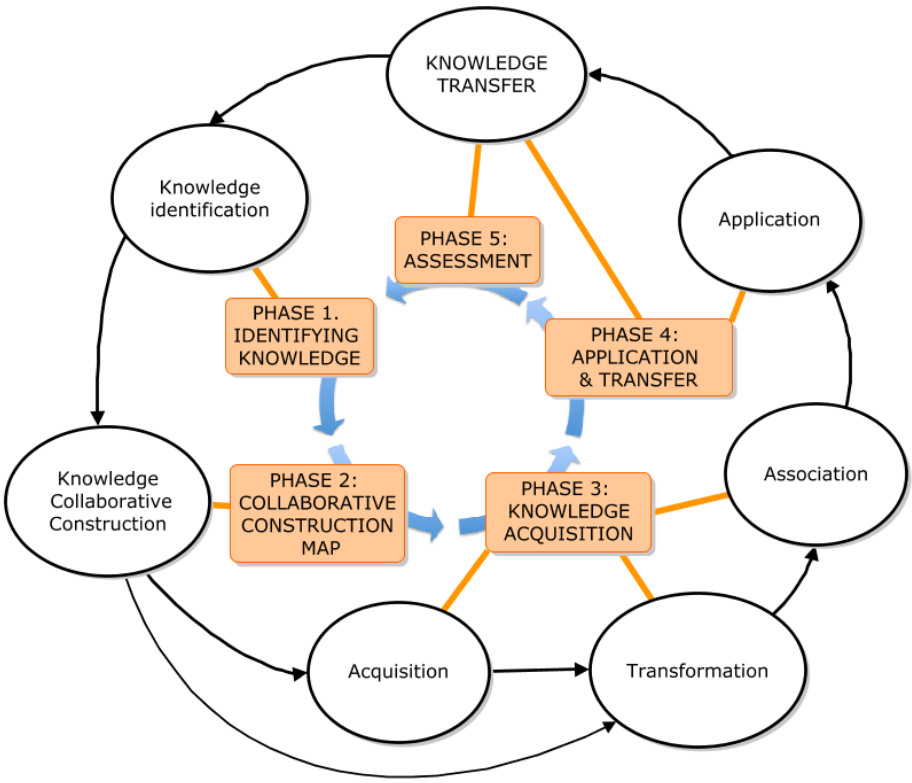

Fig. 1. Capture, representation and knowledge transfer process

2.3. Phases description

This research encompasses some phases of the procedure described above (Fig. 1), whose objective was to deeply comprehend the different factors that take part and interact in the teaching-learning process.

In relation to the first phase of the procedure, the knowledge to be transferred was identified. First, the focal question, 'How did you organize your didactic strategy supported by ICTs?', was defined. The selection of experienced teachers was carried out according to this question and they filled a survey about their best educational practices with ICT. In a third step of this first phase, an individual interview with each teacher was then conducted to explain their tacit knowledge related to "best practice". This is done through the mapping technique, thus generating a concept map.

Corresponding to the second phase, the World Cafe Cmap (WCC©) technique (Fig. 2) was applied to create a collaborative map that tries to answer a new focal question but closely related to the previous one, in this case 'How to implement active methodologies based on ICT?'.

In this way, the collaborative knowledge, previously captured individually, is extracted through the focal group technique. Through conversations on a specific topic using this methodology in workshop format, it is possible to express knowledge in a more informal way, which elicits that kind of expert knowledge that is not expressed in other areas or when they are performed by specific interviews (Trujillo, 2012; de Benito et al., 2016). The mapping technique was also used in this case. The result of the WCC© is a collaborative concept map that presents the main problems and solutions that are applied when implementing the teachers' didactic strategy supported by ICTs.

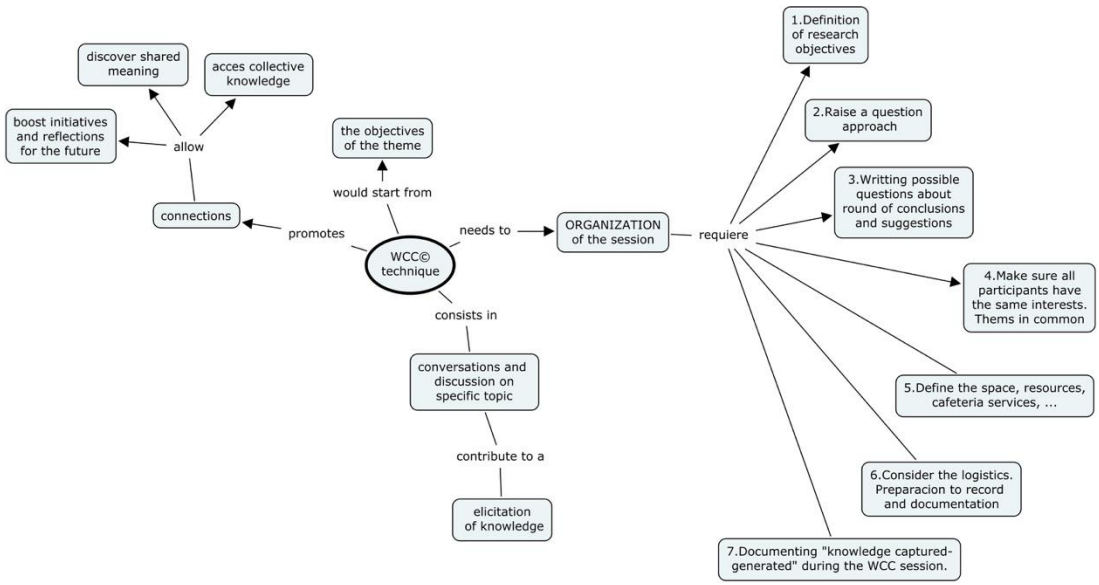

Fig. 2. WCC© technique

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The third phase includes acquisition, transformation and association of new knowledge from ideas, reflections and contributions generated during the exchange of experiences in the WCC©. Teachers can modify their individual map and add new elements related to their practice. The fourth phase refers to the application and transfer of new knowledge generated, which is incorporated into their practice. And, finally, the fifth phase involves the assessment of the knowledge application embedded into their teaching practice. This is the point in which the knowledge transfer takes place and it is shared with other university teachers through a repository of best practices. (see Fig. 3)

In this article we focus on describing the results obtained in the first two phases.

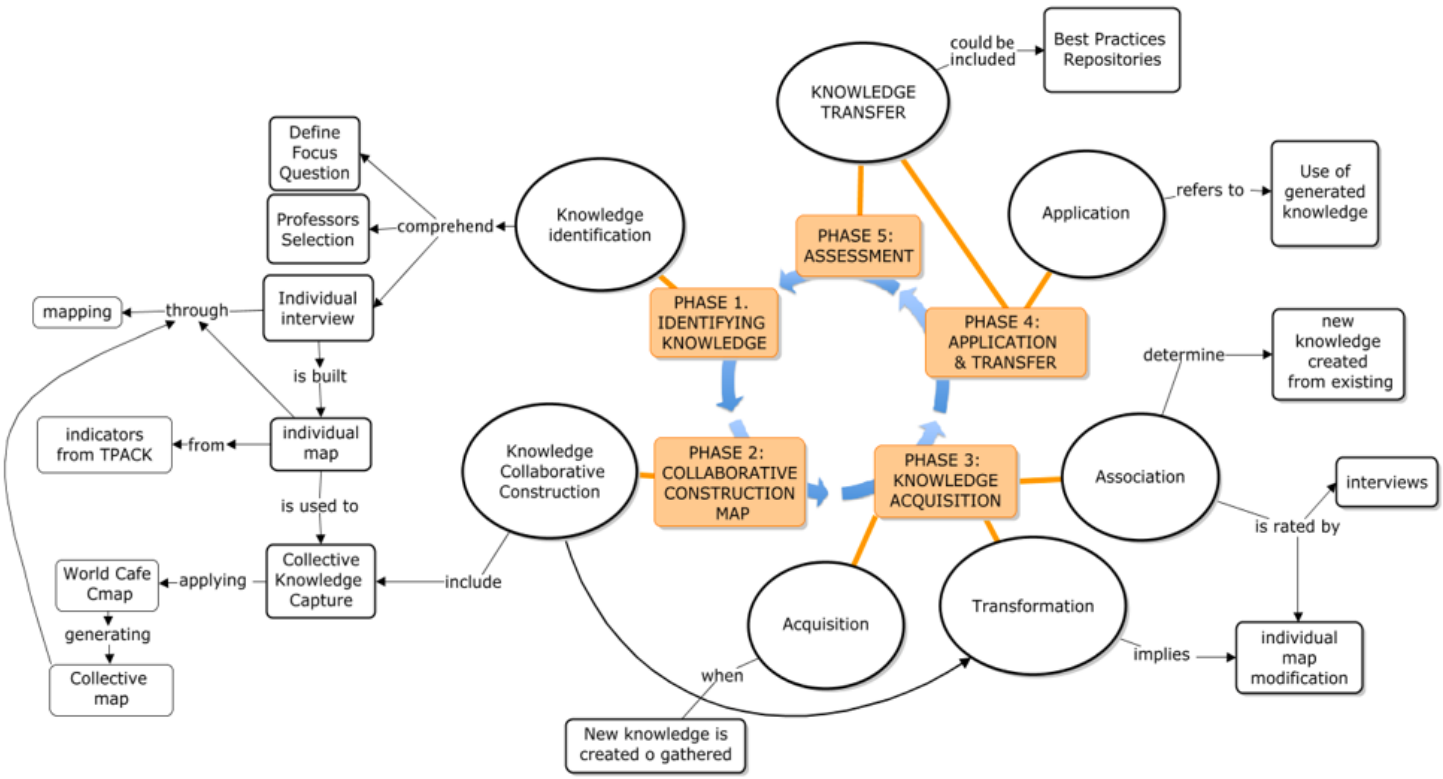

Fig. 3. Phases of the procedure

2.4. Participants

Eleven lecturers from the Faculty of Education from one Spanish university were invited to participate in the experiment. Finally, six teachers were the ones that took part in all the sessions of the workshop. They were selected based on their previous participation or

development of some innovation using ICT in their teaching, within the institutional project implemented at the university.

All participating teachers belonged to the Faculty of Education, although they came from different areas of knowledge (art, didactics, ICT, etc.) and most of them work with their students with project-based learning methods (summarized in Table 1).

Table 1
Participant profiles

	Best practice
Lecturer 1	Project-based learning: Creation of a musical composition
Lecturer 2	Evaluation: E-portfolio
Lecturer 3	Project-based learning: Creation of multimedia material
Lecturer 4	Project-based learning: Interdisciplinary micro projects with Service-Learning
Lecturer 5	Project-based learning: Service-Learning project
Lecturer 6	Project-based learning: Creation of multimedia material with Service-Learning

Table 2
Factors identified in TPACK model (Lizana, 2012)

TPACK Knowledge	Identified Factors	Concepts/Prompts
Disciplinary	Educational background; Training; Teachers' experience	Studies, professional experience, courses taught, in-service teaching training
	Knowledge on the topic	Selection and use of learning resources on the course, participation in research projects
Technological	ICT skills	Teaching influences with the use of ICT, learning tools used, application and usefulness of ICT tools, adaptation to new technologies
Pedagogical	Teaching/learning Methods and Techniques	Practical pedagogical application, usefulness for the students, strategies, activities, practice, assessment
	Planning	Pedagogical advantages, learning resources, sequencing, course content, aims, organization

2.5. Data gathering

The method adopted in this research is the concept map-mediated interview (Crandall et al., 2006; Kinchin et al., 2010). In this method, we asked open questions to the interviewee, while a mapper represents the key concepts and relationships among them. This way both interviewer and interviewee can visualize the map that is being generated in real time. In order to be able to deepen on certain aspects of the educational practice of the teacher before the individual interview, some information about their teaching guides was collected with a questionnaire, namely:

- Usefulness, which means the relevance that the teacher gives to the practice in their class.
- Description, i.e. explanation of the practice.
- Coordination, concerning the explanation of how he/she organizes the students.

The individual interview questions related to the TPACK knowledge were formulated based on the factors extracted from other previously mentioned studies, and are summarized in Table 2.

The mapping technique was also applied in the WCC© at the same time that the audio was recorded for later corroboration of the obtained material, as well as to help in the final layout of the map.

2.6. Data analysis

A qualitative analysis of the concept maps generated from the individual interviews and WCC© was carried out. Even though the factors extracted from the two first phases of the development process were used as category systems. New categories could be incorporated if the information from the professors interviewed required it.

The initial categories used were:

- Factors extracted from TPACK model: training, experience, knowledge on the course, ICT skills, teaching-learning methods and techniques, planning (Lizana, 2012).
- Different types of knowledge: TK, TCK, CK, PK, PCK and TPK (Koehler & Mishra, 2008).
- Pedagogic frailty: regulative and instructional discourse, pedagogy and discipline, research teaching nexus and locus of control (Kinchin, 2016)
- Other context variables, like as experiences, students, resources, objectives/aims, attitude, teacher training.

3. Results

3.1. Individual map analysis

The analysis of the individual maps shows five major themes through which pedagogical and technological knowledge (PTK) is mainly reflected (Fig. 4). These are:

- Teaching methodology: it describes aspects related to pedagogical elements and discipline
- Organization: it includes how teacher organize the strategy, sequence and group the students, the resources, planning.
- Evaluation and monitoring: it includes the type of evaluation criteria and processes
- Use of technology: it includes the use of ICT as a didactic tool and the instrumental skills needed to carry out the proposed activity
- Advantages and disadvantages: positive and negative aspects of the implementation of the strategy identified by the students and teachers

Dimensions of pedagogic frailty are also represented in the maps in association with concepts and prompting concept label used in Kinchin et al. (2006).

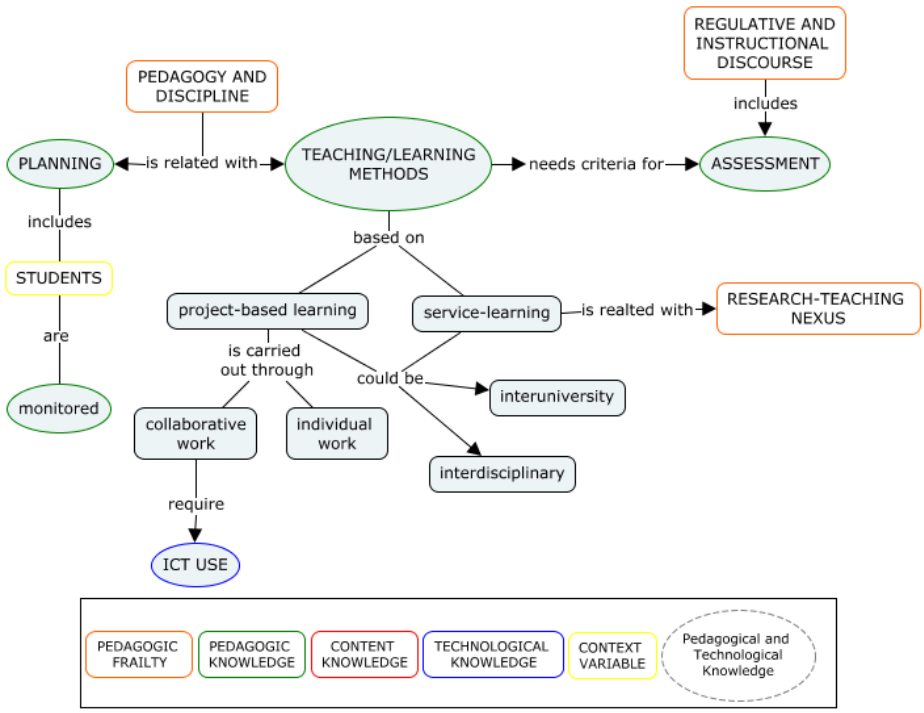

Fig. 4. Results of the analysis of the individual maps (I): Teaching-learning methods

Teaching methodology

From the different interviews, it is observed that almost all use the project-based methodology, and three of the teachers associate it also to the service-learning methodology (Fig. 5). On the one hand, project-based learning makes possible to relate the theoretical and practical contents of the course by creating a product (a report, an artifact, ...). Combined with service-learning, it offers to the students the opportunity to learn the contents in a real context, by interacting with an institution, centre or entity where they carry out the project. This also contributes to the development of works of

higher quality and improves the motivation of both students and teachers. On the other hand, some of the projects carried out are interdisciplinary, so that the products created are linked to the contents of other courses. In one case it was, in addition, an interuniversity project between different national and international universities.

Organization

Regarding the methodology, all interviewees based their activity on collaborative work (Fig. 5). The students are organized in groups, normally of 2-4 or 6-7 people. For teachers, group work has many benefits for the student, such as allowing them to manage time on their own, enhancing self-regulated learning, reducing workload, enriching learning through interaction or creating shared resources. It requires a high degree of autonomy, planning and distribution of tasks or participation.

The group work eases the teacher's task concerning the monitoring of the students' work and reduces the workload -especially in the review and follow-up. The teachers generally take advantage of the possibilities offered by the LMS for the creation of working groups, using the group forum for follow-up, resolution of doubts or group interaction. However, the main problem mentioned is how to assess the individual work and manage the participation with large groups. The techniques used to evaluate cooperative or collaborative work consist of those that appear commonly in the literature about this topic: self-assessment, co-evaluation, questionnaires or rubrics.

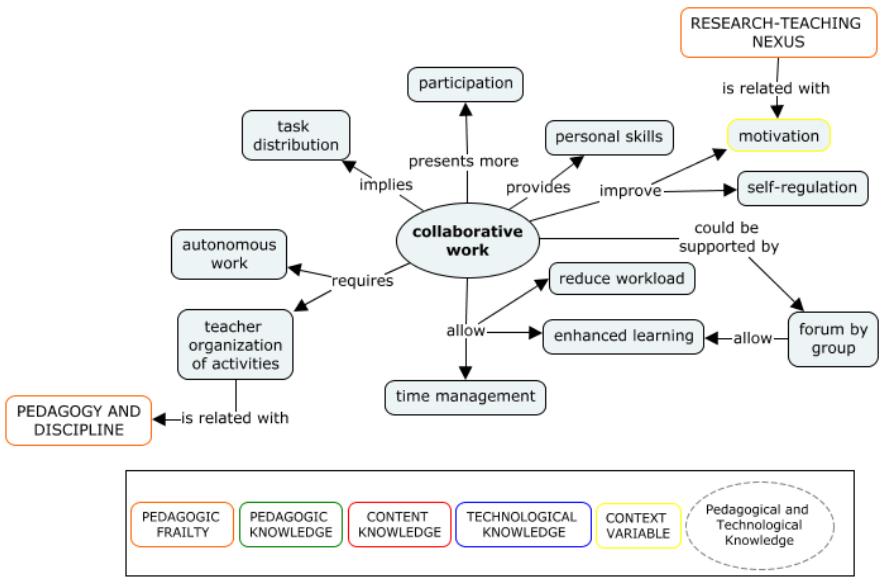

Fig. 5. Results of analysis of the individual maps (II): Collaborative work

Evaluation and monitoring

Another aspect involved in the implementation of didactic strategies supported by ICTs and that influences the organization of those is the evaluation. In this dimension teachers referred to: the evaluation of the collaborative work process, the evaluation of the product and the strategy for the follow-up of the students (Fig. 6). With regard to group work,

three options of assessment are mentioned: teacher evaluation, self-assessment and co-evaluation (intergroup and intragroup). They usually use a rubric in digital format, which facilitates the collection, analysis and treatment of data. In most cases, the co-evaluation is based on oral presentations on their work by each of the groups.

Concerning monitoring, this is done through deliverables, discussion forums, questionnaires or an e-portfolio. According to the teachers, monitoring is important to know the work done by the students as well as to provide them feedback throughout the process. Although the teachers consider it as a key element in the learning process, they also express that monitoring requires a lot of time for them due to the large number of students in their courses. The monitoring is usually done in person, through videoconference or forums (individual or group). Due to the high number of students, some of the teachers continue using the exam or the test evaluation as the technique of assessment in order to determine if the students have achieved the learning objectives of the course.

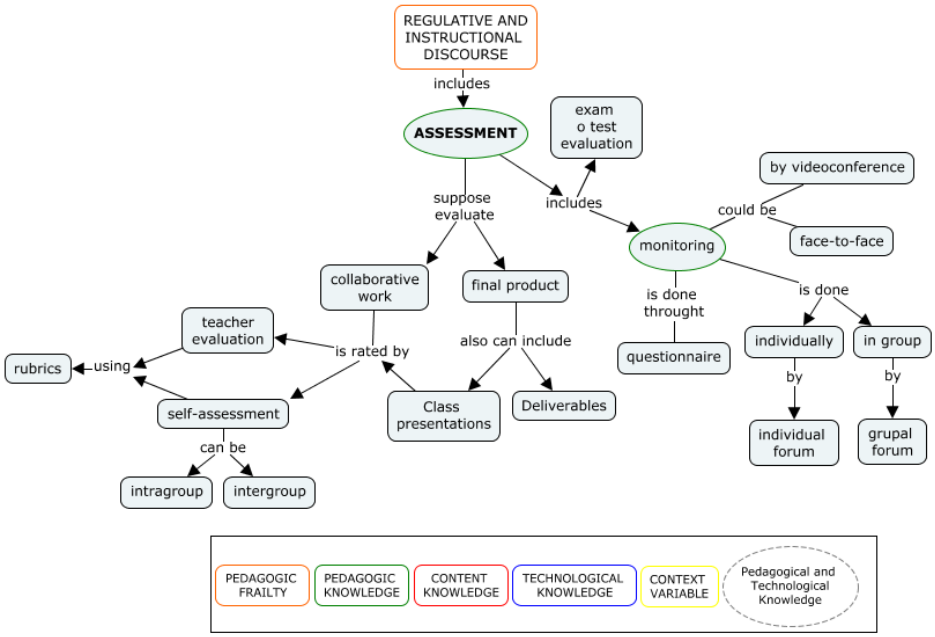

Fig. 6. Results of the analysis of the individual maps (III): Assessment

Use of technology

With regard to the use of technology, it is possible to differentiate between a) the instrumental use of certain technologies for the creation or the generation of artifacts or products by students (e.g. for the creation of multimedia materials or musical compositions) and b) the didactic use of ICT by the teachers (Fig. 7). In reference to the latter, all teachers use the institutional LMS, but they also incorporate external applications such as Twitter, Google Drive and Blogger, among others. The LMS is mainly used to organize the students' tasks, to collect the different deliverables, to distribute the grades and to give feedback and foster communication with and among the students. Technology-enriched environments involve the acquisition of instrumental skills that are related to digital competence and, in the case of teachers, also to digital

teacher competence. The teachers did not express any problem related to the use of technology and their lack of digital competence. With regard to students, this competence may come from different areas: personal use of technology -usually acquired through the use of smartphones-, self-training -in some cases related to professional performance-, and in practice workshops within the same course.

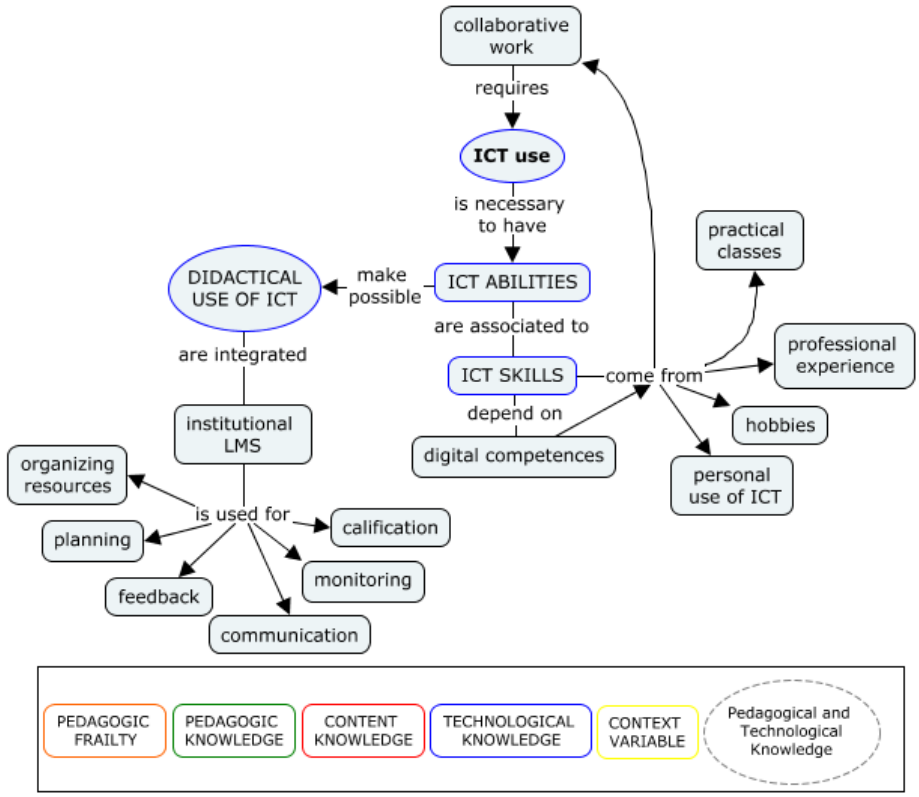

Fig. 7. Results of the analysis of the individual maps (IV): Use of ICT

3.2. Collaborative map analysis

Based on the knowledge of how the teachers organize their didactic strategy, reflecting on how to implement active teaching methodologies with ICT was one of the proposals in the WCC©. The collective map that was generated highlighted different concerns. The most important are the students' perception of the effort involved in this type of methodologies, the large number of students, the attitude of the students and the amount of work involved for the teacher, especially in relation to the monitoring and learning assessment (Fig. 8).

The teachers considered that the self-perception of the students is that they devote much more time to the proposed activities in this type of methodologies than in another type of course of a more transmissive nature. In fact, teachers frequently find this aspect in the students' evaluations on the quality of teaching at the end of the semesters.

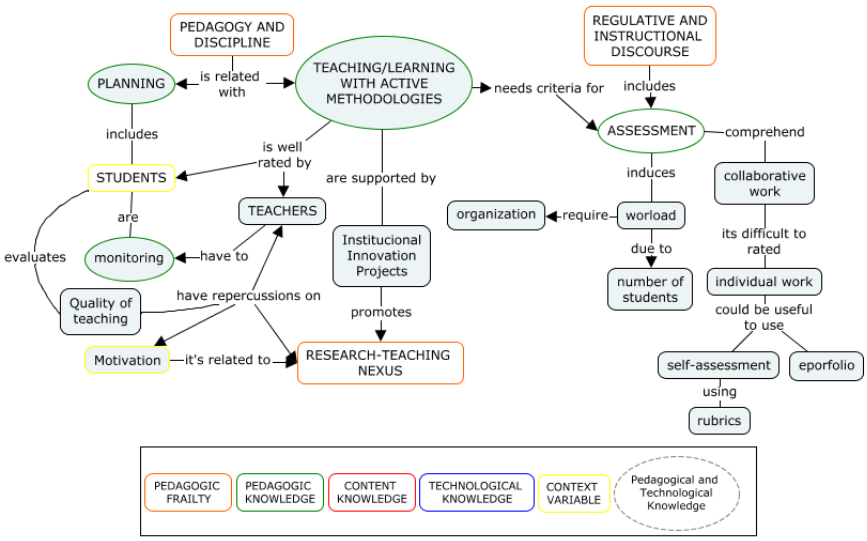

Fig. 8. Results of the analysis of the individual maps (V): Teaching-learning with active methodologies

In recent years, the attitude of the students is changing as regards the demand of feedback. They want it continuously and quickly, which causes stress in the teachers since they are not able to answer all the students at a time due to their high number. This attitude has a direct relation with the level of satisfaction of the teacher and with the classroom atmosphere.

In this sense, the large number of students has been the most discussed aspect. On the one hand, it conditions the implementation of projects or activities of innovation since it is difficult to manage both the monitoring and participations of the students and the feedback of the activities. On the other hand, it forces teachers to create working groups or to use more classical, transmissive methodologies.

The organization of studies per semester and the duration of these has also consequences for the management of large groups, as it is difficult for the teacher to know their students well, to adapt the activities to the individual characteristics or to monitor quality.

The institutional system of assigning students to each group of courses creates disadvantaged groups, which also impacts negatively on the teaching task.

In the case of group work, one of the main and complicated problems that arise is the individual evaluation. Co-assessment could be a good technique for this evaluation, providing different possibilities, like the division of the final grade among or intragroup evaluation.

On the other hand, innovation generates uncertainty for students, since they usually have few competences with regard to the self-regulation of their learning (organization, creation). A positive evaluation of the institutional support for the

development of teacher innovation projects boosts the nexus between research and teaching.

4. Conclusions and implications

This study used a design-based research methodology to grasp the knowledge of faculty members concerning their expertise in pedagogical technological knowledge connected to the use of active teaching methodologies using ICT. The analysis of the maps of faculty members included the use of many educational innovations, such as online learning systems, intelligent tutors, collaborative training tools, learning with mobile devices, educational games, simulation systems, web services and authoring tools. The analysis of the maps shows the implementation of many innovations with ICT (project-based learning, service-learning, collaborative learning) and their positive aspects and the difficulties in carrying them out.

The use of the procedure shows the importance acquired by the adaptive experience -whose structures are represented by concept maps- in the development of pedagogical technological knowledge. In all cases, these experiments had constantly consideration of the student, rather than focusing on the discipline. The teachers involved pointed to some of the dimensions of pedagogical frailty as conditions for a greater progress in innovative experiments using ICT, although they did not mention many possibilities for their own professional development, as Kinchin et al. (2016) or Kinchin and Winstone (2017) pointed. In this sense, it is observed that the number of students in each course, the organization of teaching, faculty teaching loads do not support a work oriented to a higher level of dialog among students or the development of the learning in the student, to the extent that teacher would desire.

The use of concept maps in our case studies, especially in the latter, contributes to two very concrete purposes:

- Concept maps are a suitable and very useful tool for the elicitation and representation of expert pedagogical knowledge, which means here, for representation and collaboration in research,
- Concept maps are showed as a way of representing knowledge - in this case the technical, pedagogical and disciplinary TPACK -, which allows the navigation through the model of expert knowledge in terms of teaching with technologies. It is also a non-linear presentation way of the knowledge structure, which can be shared, analyzed and reconstructed in the network generated among peers and in the community of practice generated.

Continuing professional development of teachers is key, both to improve educational performance and its effectiveness, and to improve teachers' commitment, identity and job satisfaction (Feiman-Nemser, 2008; European Commission, 2013; Kinchin & Winstone, 2017). This development has evolved, becoming more and more academic, professional and disciplinary over the years, putting always a greater weight on the disciplinary knowledge instead of the pedagogical aspects (Gibbs, 2013). In our case studies, however, this does not apply, because the results reveal that the importance is also attached to the pedagogical knowledge.

In our future studies, a focus on distinguishing between didactic competences and teacher competences seems to be useful (OECD, 2009). The didactic competences focus on the role of the teacher in the classroom or in technology-enhanced learning

environments, directly linked to the task of teaching, with knowledge and professional skills mobilized for action (Hagger & McIntyre, 2006). The teachers' competences imply a broader and systemic view of the professionalization of teachers at multiple levels: the individual, the school, the local community and the professional networks.

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