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Inverted classroom with problem-based learning and guidance through project, supported by knowledge management

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ABSTRACT. Higher Education has gone through a resignification process of its pedagogical processes, as the traditional concept of teaching can no longer be accepted. Traditional teaching disregards the student as part of knowledge construction and development, and considers them as mere spectators of the teacher. Currently, active methodologies stand out, as they seek to stimulate students' professional practical learning. This article aims to present how Knowledge Management (KM) practices and tools can be integrated in the planning of a sequence of classes that follows the proposal of the Flipped Classroom based on Project Problems and Orientation. The methodology is applied in nature with a qualitative approach, with exploratory bibliographical research and a case study carried out in a subject of a face-to-face Software Engineering course. Data collection was developed through a document study of the professor's class records. The content analysis allowed us to verify the easiness and difficulties of applying the proposed lesson planning. This article demonstrates that the flipped classroom proposal applying Problem-Based Learning and Organizational Management Project with KM practices and tools can be a pedagogical proposal to allow the KM cycle to occur between students and teachers, both face-to-face and online.

Keywords: lesson planning with active methodologies; case study; KM practices and tools; flipped classroom.

Sala de aula invertida com aprendizagem baseada em problemas e orientação por meio de projeto, apoiada pela gestão do conhecimento

RESUMO. A Educação Superior tem passado por um processo de ressignificação de seus processos pedagógicos, pois contemporaneamente a concepção tradicional de ensino não pode mais ser admitida, uma vez que considera que o aluno não faz parte da construção e do desenvolvimento do conhecimento, mas é apenas um espectador do professor. Assim, atualmente, as metodologias ativas têm destaque, pois procuram estimular uma aprendizagem prática profissional dos alunos. O presente artigo tem o objetivo de apresentar como as práticas e ferramentas da Gestão do Conhecimento (GC) podem ser integradas no planejamento de uma sequência de aulas que segue a proposta de Sala de Aula Invertida com Aprendizagem baseada em Problemas e Orientação por meio de Projeto. A metodologia adotada é de natureza aplicada com abordagem qualitativa, sendo realizados pesquisa bibliográfica exploratória e estudo de caso em uma disciplina do curso de Engenharia de Software na modalidade presencial. A coleta de dados foi desenvolvida por meio de estudo documental do registro das aulas do professor. A análise de conteúdo permitiu verificar quais são as facilidades e dificuldades em aplicar o planejamento de aulas proposto. Este artigo demonstra que a proposta de sala de aula invertida aplicando PBL e OMP com práticas e ferramentas de GC pode ser uma proposta pedagógica que permite que ocorra ciclo da GC entre alunos e professores, tanto no modo presencial quanto no virtual.

Palavras-chave: planejamento de aulas com metodologias ativas; estudo de caso; práticas e ferramentas da GC; sala de aula invertida.

Aula Flipped con aprendizaje basado en problemas y gerencia de proyectos organizacional respaldado por la gestión del conocimiento

RESUMEN. La Educación Superior ha atravesado un proceso de resignificación de sus procesos pedagógicos, ya que el concepto tradicional de enseñanza ya no puede ser aceptado. Desprecia al alumno como parte de la construcción y desarrollo del conocimiento y los considera meros espectadores del docente. Actualmente, se destacan las metodologías activas, que buscan estimular el aprendizaje práctico

profesional de los estudiantes. Este artículo tiene como objetivo presentar cómo las prácticas y herramientas de Gestión del Conocimiento (KM) se pueden integrar en la planificación de una secuencia de clases que sigue la propuesta del Aula Flipped basada en Problemas y Orientación del Proyecto. La metodología es de carácter aplicado con enfoque cualitativo, con una investigación bibliográfica exploratoria y un estudio de caso realizado en una asignatura de un curso de Ingeniería de Software presencial. La recolección de datos se desarrolló a través de un estudio documental de los registros de clases del maestro. El análisis de contenido nos permitió verificar las facilidades y dificultades de aplicar la planificación de lecciones propuesta. Este artículo demuestra que la propuesta de aula invertida aplicando el Proyecto de Aprendizaje Basado en Problemas y Gerencia de Proyectos Organizacional con prácticas y herramientas de KM puede ser una propuesta pedagógica que permita que el ciclo de KM ocurra entre estudiantes y docentes, tanto presencial como online

Palabras clave: planificación de lecciones con metodologías activas; estudio de caso; prácticas y herramientas de KM; Aula Flipped.

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Introduction

In the current higher education scenario, transformations in the teaching process to engage and identify the students' interests have been observed (Reis & Pena, 2020). In this transformation, students' learning needs to be associated with their motivation, interests and involvement (Reis & Pena, 2020). However, this is a challenge for the teaching actions, as in undergraduate courses a certain level of demotivation from students with regard to the teaching and learning process is noticed. According to Behrens (2015), this situation is caused by the deficiency of practices to strengthen the training of these students as professionals. Therefore, adopting pedagogical processes to allow the discussion and problematization of the reality experienced by students, enabling their reflection and fostering greater creativity and critical thinking are deemed necessary (Behrens, 2015). Examples of activities that propose the application of active methodologies can be recognized, such as: peer learning, group discussions, case studies, flipped classroom, collaborative learning, problem-based learning, team-based learning, project-based teaching, among others (Marin et al., 2010).

This article is based on the Flipped Classroom methodology, by Bergmann and Sams (2016), which proposes flipping the traditional teaching model, with fewer lectures, however, more productive, collaborative and participatory. Importantly, the Flipped Classroom has been the subject of studies by authors such as Strayer (2007), Schneider, Suhr, Rolon, and Almeida (2013), Munhoz (2015), Honório (2016), and Suhr (2016).

Strayer (2007) defines the Flipped Classroom as an innovative classroom structure, in which the lecture takes place outside the face-to-face classroom environment, using technology, and applying homework and practice with concepts within the classroom, through learning activities. Schneider et al. (2013), in turn, argue that the pedagogical proposal behind this idea of flipping the classroom has theoretical support by Bloom, an American psychologist, who in 1956 wrote the Taxonomy of Educational Objectives. These same authors point out that Bloom's objective at the time was to describe the educational objectives, from the simplest to the most complex, and, therefore, allow the planning of teaching processes (Schneider et al., 2013, p. 72).

Munhoz (2015) defines the Flipped Classroom as a methodology to 'invert' the cycle of content acquisition and application so that students have contact with essential knowledge, before the face-to-face class. This prior access may be through a virtual learning environment or with the distribution of items and reading materials made available in the class plan so that, in the classroom, students and teachers can actively interact in situations and moments aimed at explaining, developing, and applying the previously constructed knowledge.

It is understood, in this article, that the Flipped Classroom not only inverts the structure of the learning process but also transforms the roles of students and teachers (Honório, 2016). Given the proposal of this teaching strategy - to distance itself from the traditional teaching model -, the Flipped Classroom focuses on the students' involvement and greater autonomy, who are committed to being previously involved in their learning process, without necessarily waiting for an informative protocol or a lecture under the teacher's responsibility.

Suhr (2016) considers that the Flipped Classroom is a possibility for organizing sequences of activities defined according to problem situations which lead students to solve problems, preferably deliberated in groups.

In the context of active methodologies, innovative teaching strategies and the purpose of flipped classrooms, the proposal of Problem Based Learning (PBL) or the proposal of Organizational Management Projects (OMP) are identified as possible resources to support lesson planning. The PBL is a methodological proposal, developed by Howard Barrowsem in 1969, at McMaster University, aiming at the study in medicine courses. Currently, it is found in different contexts of the educational system, ranging from Basic Education to Higher Education.

Ribeiro (2010) describes PBL as a collaborative, constructivist, and contextualized teaching and learning methodology, in which problem situations are used to set up, direct, and motivate the learning of concepts, theories, and the development of skills and attitudes in the classroom context. Alarcão and Tavares (2013) reinforce that PBL leads to the recognition that knowledge needs to be understood and conceptualized by students in a more active, autonomous, and collaborative way, not as simple information acquisition but as production, knowledge construction, experience, and life. Farias, Martins and Cristo (2015) claim that PBL values prior knowledge and indicate that students' motivation follows when they are involved in solving the problem presented by the teacher, allowing these students to examine, reflect and take a stand on the content. Gomes, Brito and Varela (2016) highlight that the interest in PBL lies on a dichotomy between training and professional practice, as it intends to replace processes of memorization and transfer of unidirectional and fragmented scientific knowledge by self-learning.

Regarding the OMP, Bordenave and Pereira (1982) explain that this proposal can help the student to get information, read, talk, write down data, calculate, putting together what is necessary to start their project. Blumenfeld et al. (1991) indicate that the idea of working with projects in the educational environment is not new, but the important advances in knowledge about motivation, learning, teachers, and the classroom broaden the positive perspective regarding the OMP.

According to Abrantes (1995), the OMP allows the development of responsibility and autonomy of students, the project authenticity, the involvement of complexity and problem solving. Specific knowledge, in the disciplinary format, offers the student the possibility of recognizing and involving the particularities of a given content, while interdisciplinary knowledge allows establishing significant relationships between knowledge, which emphasizes the relevance of the OMP (Prado & Almeida, 2003). In this sense, the student's production arises from problems capable of boosting the contextualization of concepts already known to them and in promoting other problems. Therefore, the OMP promotes problematization and interaction with different areas of knowledge (Vilarinho, 2004; Prado, 2005).

Moran (2015) exemplifies the OMP through Summit school projects, where projects are developed between individual activities and group activities and with the teacher’s guidance from different areas. This multidisciplinarity favors a global and integrated view of contents studied in different subjects. Valente, Almeida, and Geraldine (2017) add that, for developing projects, the teacher can work with students on different types of knowledge, represented by problem-solving procedures and strategies, subject concepts and strategies, and concepts about learning.

This study has identified that the learning that takes place through projects, with the development of activities under the students’ responsibility and aimed at activating their learning process; learning is no longer a mere mechanical activity and allows discoveries and better interaction between the students and the teacher through problem-situations solving.

The literature has indicated that scholars have discussed the application of active methodologies (through studies on flipped classrooms, PBL, and OMP) in undergraduate courses in Higher Education Institutions (HEIs), referring to the relevance of acquisition and construction of functional and meaningful knowledge for professional performance.

Alarcon (2015) associates a set of Knowledge Management (KM) practices and tools with active methodologies, aiming to explain how KM can contribute to teaching and learning processes engaged in encouraging the acquisition of functional and practical knowledge. Davila, Fraga, Diana and Spanhol (2015) explain that there is a link between knowledge and its holders to contribute between users and members of the organization; in this study, the teacher and the student, respectively, present in the classroom and representatives of an educational organization.

According to Batista (2004), KM practices and tools can be understood as implementation strategies that allow both capturing and reusing structured knowledge; capturing and sharing lessons learned from practice; identifying sources and networks of expertise; structuring and mapping the knowledge needed to increase the design; mediating and controlling the economic value of knowledge; and synthesizing and sharing from external sources. This is reflected in the link between the use and application of the teacher’s teaching

strategies and methods, which enable the student to identify, analyze and apply theoretical content in a practical perspective when inserted in the proposals for innovative methodologies (Dal Forno, 2019).

Dalkir (2005) highlights that the KM cycle occurs through knowledge creation/capture, knowledge sharing/dissemination, and knowledge acquisition/application. Creation/capture is about identification, followed by the codification of both internal knowledge and knowledge from the external environment. The author indicates that sharing/dissemination allows an assessment of the created/captured knowledge. The acquisition/application stage takes place only after the validation and assessment of knowledge as relevant, which is then stored and used in personal and organizational actions.

The learning process is no longer associated with lectures by the teacher, but with learning management, which, according to Salvador (1994) and Cosenza and Guerra (2015), refers to student's skills and abilities to validate their knowledge and its meaning for their reality, for their performance and application. Knowledge acquisition and application are understood as students' tasks through their learning management.

As this research involves the areas of Education and Knowledge Management, it presents an application of the lesson planning proposed by Fiorini (2019) to verify how Knowledge Management practices can be used in applications of the Flipped Classroom methodology in the teaching and learning process in face-to-face undergraduate courses. The research methodology is applied in nature, using exploratory research, qualitative explanatory research, and Participatory Action Research, and using a specific cut on the Flipped Classroom and application methods of PBL and OMP with KM practices and tools.

Lesson planning from a flipped classroom perspective

For a better understanding of the lesson planning proposed in this article, Figure 1 shows the KM practices - according to the Asian Productivity Organization [APO] (2020) manual - used in lesson planning. It is noteworthy that KM practices are dynamic actions that enable a flow of knowledge sharing, as well as a flow of knowledge dissemination to promote knowledge reuse or updating.

'Document Management System' – Efficient and effective way to access documents to avoid information overload. Fundamental to finding the right information at the right time. 'Brainstorming' – Used to help the team generate ideas and innovation. The process is divided into two phases: divergent and convergent. In the divergent phase, the team generates insights, postponing judging the ideas and then, in the second phase, deciding and selecting the best ideas. 'Advanced Search Tools' – Search engine for significant improvement in search results. Ways to get the right information and decrease information overload. 'Narratives' – Used to share experiences and learned lessons, through reports and events that consist of literally telling stories in a simple way, using words and images. 'Collaborative Virtual Space' – Allows people to work collaboratively, sharing documents, collaboratively editing in co-authorship, audio and video conferencing, regardless of their physical location. 'Social Media Space' – Group of people who share a common area of interest. They are online social support systems for finding people with common needs and interests, sharing relevant content and documents. 'Blog' – Diary that contains a list of entries, generally in reverse chronological order. Entries are short articles or stories relating to current events. 'Discussion Forum' – Used to discuss and share information, ideas and experiences that will contribute to the development of skills and improvement of the organization's processes and activities. 'Learning Review' – Used by the project team to assist in learning the work process. The goal is for team members to be able to learn continuously throughout the project.

Figure 1. Knowledge Management Practices.
Source: Adapted from Fiorini (2019).

The practices presented in Figure 1 improve individual and group performance in organizations if they are aligned with identification (IDE), creation (CRE), storage (STO), sharing (SHA), and application (APP). Table 1 highlights the stages of the Knowledge Management cycle that occur with the application of these practices.

Table 1. Knowledge management practices and cycle.

KM Practice	IDE	CRI	ARM	COM	APLI
Document Management System			X	X	X
Brainstorming		X			
Advanced Search Tools	X	X			X
Narratives				X	
Collaborative Virtual Space	X	X	X	X	X
Social Media Space				X	
Blog		X	X	X	X
Discussion Forum				X	
Learning Review		X	X	X	

IDE - identification; CRE - creation; STO - storage; SHA - sharing; APP – application (Adapted from Fiorini, 2019).

The recognition of KM practices also reflects on the understanding that the relationships established in an organization refer to the integration among three factors - People, Processes and Technology - which result in a flow of dynamic actions that permeate the assessment, contextualization, and updating, as represented by Davila et al. (2015). Similarly, this relationship established among People, Processes and Technology in the Flipped Classroom, through the involvement of Teachers and Students (i.e. People) who develop and apply teaching strategies (i.e. Processes) with the use of KM practices and tools (i.e. Technology), as shown in Figure 2.

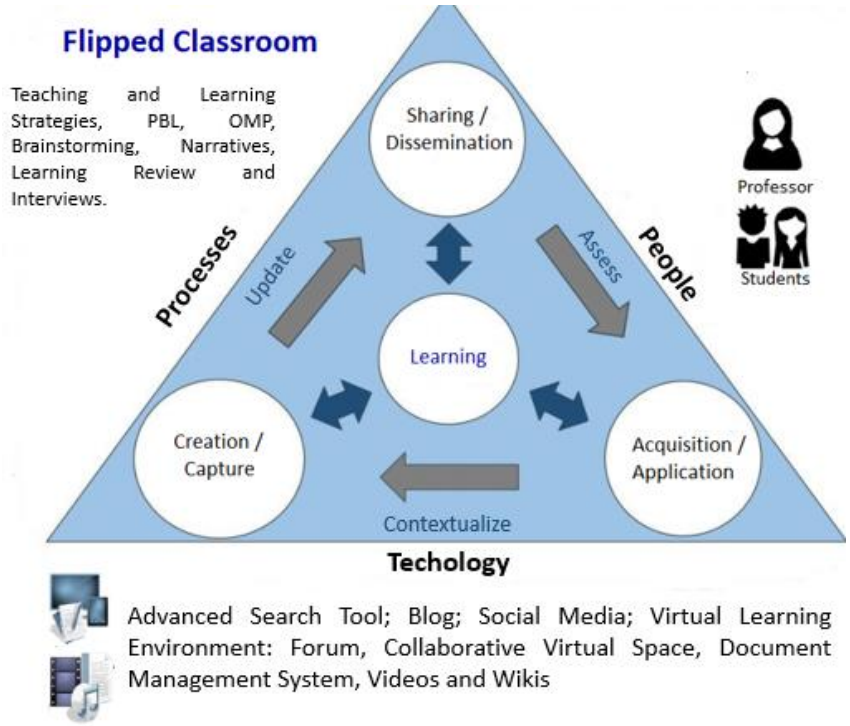

Figure 2. Flipped classroom vs knowledge management.
Source: Fiorini (2019, p. 103).

The Flipped Classroom methodology proposes three moments 'before', 'during', and 'after'. However, as this methodology does not specify strategies or resources to be used in the three moments, the practices presented in Figure 2 allow filling in this gap in the Flipped Classroom. In addition, the choice of the KM practice must always consider the occurrence (partial or total) of the KM cycle. Figure 3 shows a refinement of the Flipped Classroom proposed by Bergmann and Sams (2016), in which PBL and OMP strategies were applied. Figure 4 shows the organization of the KM cycle through the proposed lesson planning.

During the 'first face-to-face class', the teacher/researcher presents the Flipped Classroom proposal to the students, informing them about the objectives of the proposal, as well as all the steps to be experienced in the following classes, bringing a brief training about the technological resources to be used in the following classes. 'Prior to the second class', the teacher selects the contents, collects videos and articles on the topic of the class, which, during the class, will be shared with students to read the articles and watch the videos accessed through the Document Management System (DMS). In the 'third face-to-face class', Brainstorming will be held. Finally, there is a general discussion and closing of the class. For the 'fourth face-to-face class', advanced search tools and narrative presentation will be used. For this, the professor discloses information about advanced search tools available to students and they research on possibilities, examples, and solutions on the themes discussed in the classroom. As a final product, students produce individual narratives about the found/studied solutions and send them to the professor, using sharing tools chosen by the professor (email, virtual learning environment, DMS). During the 'fifth class', the Collaborative Virtual Space will be used to build a project. Students will follow the professor's instruction and start, as a group, the creation of the project. During the 'sixth class', students continue to create a project, using the Collaborative Virtual Space. After class, the students publish the first steps of their projects on Social Media Space. In the 'seventh class', the projects will be presented through narratives, using audiovisual resources. This activity encourages interaction between students and the professor, generating reflection and knowledge. Virtually, after the 'eighth class', the students publish the projects presented in the previous class in a Blog created by the professor with an integration between the students and formalization of their opinions on the classmates' projects, through a discussion forum. Finally, 'before the ninth class', the professor extracts the students' main ideas from the Blog posts. During the class, these keywords are shown to the students, who, in turn, create the concept map on the board, ending with a brief discussion of the created concept map.

Figure 3. Lesson Planning.
Source: Adapted from Fiorini (2019).

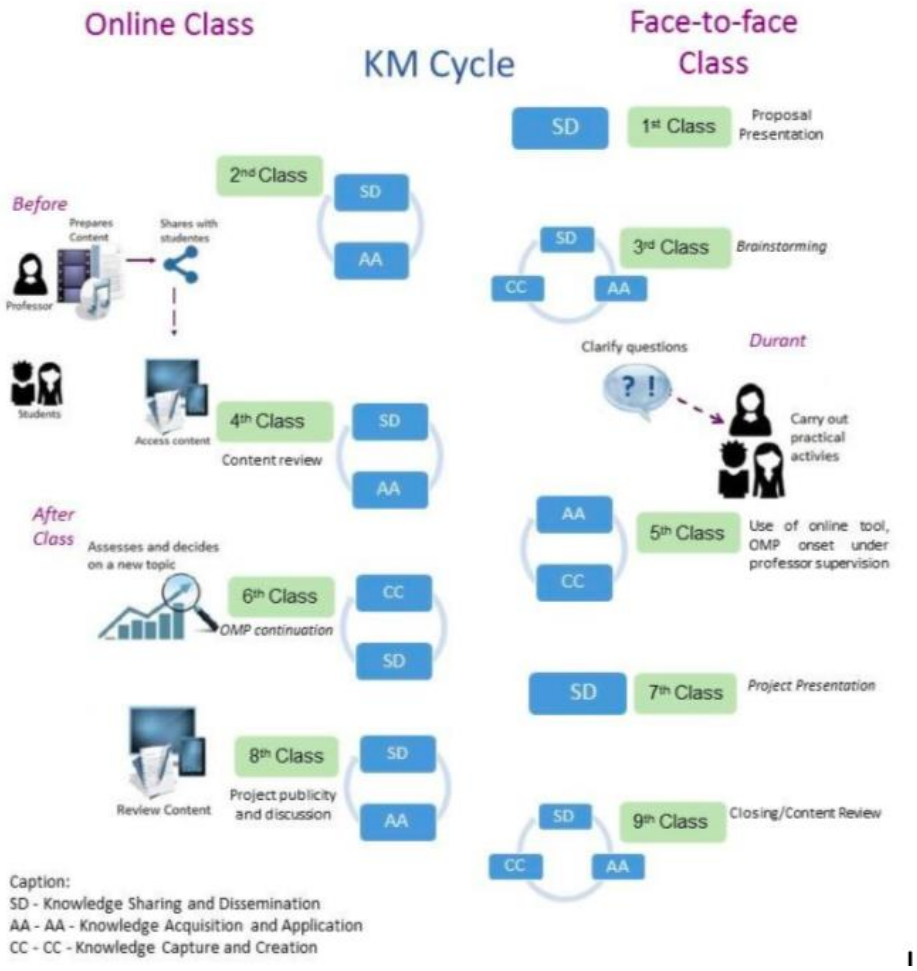

Figure 4. Flipped Classroom Planning.
Source: Adapted from fiorini (2019).

Methodology

The methodology is applied in nature with a qualitative approach, with exploratory bibliographical research and a case study carried out in a graduate course. According to Gerhardt and Silveira (2009, p. 41), exploratory research aims to provide greater familiarity with the problem, to make it more explicit, or build hypotheses. Most of them involve (a) literature review, (b) interviews with people who have had practical experience with the research problem, and (c) analysis of examples that encourage understanding".

As for a case study, according to Ventura (2007, p. 384), it is a research modality understood as a methodology or as the choice of an object of study defined by the interest in individual cases. A case study aims to investigate a specific, well-defined case, contextualized in time and place so that a detailed search for information can be carried out.

Data collection was carried out through a document study of the teacher's class record with content analysis which, according to Bardin (2002), can be performed from any written record or in a magnetic medium used as a source of information. Content analysis, according to Bardin (2002, p. 9-10), oscillates between the two poles of the rigor of objectivity and the fruitfulness of subjectivity. It absolves and warrants the investigator for this attraction to the hidden, the latent, the non-apparent, the unheard (of the unsaid) potential retained in any message.

Content analysis followed the proposal of Mayring (2010, p. 602), performing an interpretive analysis of texts, through discourse decomposition and rational reconstruction of a central idea with the application of logic rules regarding the origin of these messages to create categories, and Vergara's (2010) proposal, seeking to identify what is being said about a certain topic. Finally, this research was submitted to the Ethics Committee, via Plataforma Brasil, and was approved under No. 3.158.203 (CAAE: 03709318.6.0000.5539), February 20, 2019.

Applying flipped classroom planning

The case study was carried out in a subject of an undergraduate course in Software Engineering in a face-to-face course of a HEI in the Metropolitan Region of Maringá, Paraná State, Brazil. The Virtual Learning Environment (VLE) of the IES case study was used to provide content and activities to be carried out by the students at home (following the 'before' and 'after' proposal of the Flipped Classroom). Thus, during the face-to-face moments, the results could be discussed with the professor's support (following the 'during' the Flipped Classroom) as shown in Figures 5 and 6.

Figure 5. Students using a board to organize the group's ideas.
Source: Authors' archive.

The document analysis was conducted from the records of the Software Engineering professor's classes. These records served to identify the professor's difficulties and/or easiness in following the planning, by detecting differences in student acceptance and participation in the applied classes, considering the specificities of these students' academic training. The records made by the professor followed a textual format, in which the strategies were described step by step, the obstacles and easiness during the application, highlighting how the students' acceptance and participation in the classes took place.

Figure 6. Students participating in the Brainstorming.
Source: Authors' archive.

- First class: The class has little or no contact with innovative pedagogical practices. It was decided that the practice would not be elucidated, but that it would be explained as a proposal for 'final work activities to be developed'. Therefore, students did not have the perception that differentiated classes would be applied. The proposal was that students should present a project for an interface for an information system aimed at solving the existing problem in a psychology clinic: allow the management of patients in a psychology clinic. Training for technological resources was unnecessary, as the students were familiar with the resources to be used (access to material in the VLE, submission of material in the VLE, participation in a forum, search for material on the internet).

- Second class: The provided material aimed to clarify the development of an interface project for the presented problem. Therefore, materials referring to the first task that the students should develop were separated: requirements engineering techniques with the customer. In addition, material referring to the information system for scheduling management and a Wiki for defining workgroups was made available.

- Third class: The class resulted differently than planned, as the clients (clinic's secretary and psychologist) came to the school that day (and not in the following class, as previously arranged). The class had two moments. First, the discussion with the students about what they read/researched about techniques for performing Requirements Engineering. Therefore, the first part of the class consisted of applying the interview technique; the professor acted as the mediator and encouraged students to ask questions so that they could better understand the client's needs. In the second part of the class, after the secretary and the psychologist left, each group summarized what the clients said, to be able to register and share via the Discussion Forum in the VLE.

- Fourth class: Each group (with the professor's support) started the creation of their interface project. The narratives were textual (summary of the customer's needs) and graphic (paper draft of what each interface should look like). Finally, the students should publish the client's needs on the VLE Forum.

- Fifth class: A tool to construct the interface project collaboratively was presented. The students started activities in the classroom and were informed that they should deliver the activity the day before the following class.

- Sixth class: A Forum was created on the VLE for the solution built by the tool - images of the information system screens.

- Seventh class: As the students posted the wrong/incomplete work, the professor chose to present the deliveries (without identifying the authors), highlighting both the good aspects and the problems in each proposal. After the first presented works, the students started to criticize/comment on the works being presented.

- Eighth class: Students redid the work previously delivered, considering the discussed comments.

- Ninth class: The learning review was carried out through a discussion about the first delivery and the final delivery of the interface project for the presented problem. Their attitude as professionals and the Requirements Engineering technique was also discussed both in positive and negative points.

The application of the nine classes of the pedagogical proposal in the Software Engineering course allowed us to validate and understand the acceptance (or not) of the professor regarding this proposal. In addition, the professor's class records aided with the detection of the group's difficulties and/or easiness according to the proposal. For this purpose, an unstructured interview was applied to obtain a detailed description of the professor's perceptions about the applied classes; perceptions that could not be fully disclosed in the records.

The proposal of the '1st class' consisted, basically, in training the students to participate in classes developed within the Flipped Classroom method. The professors explain to the students the proposal of the nine classes and how the use of technological resources should be in the classroom. In this case, the professor decided not to explain the Flipped Classroom proposal to the students, though. The idea was to facilitate the acceptance of the proposal, given that these students are not familiar with active methodologies. Perhaps, the students could feel uncomfortable participating in an unknown methodology. Due to the students' training in Software Engineering, there was no need to prepare them for the technological resources proposed in the classes, as the students were often using them. However, the students found it difficult to understand the methodological proposal, coming to participate more actively only in the last classes. In this sense, this study recognizes that the Flipped Classroom application needs to consider, as a basic assumption, the training of participants in the methodology procedures.

The '2nd class' proposal was worked out exactly as planned, using technological resources for the development of the 'before', remotely. The objective of the class was achieved, as the professor was able to

prepare and share the materials with the students and they were able to prepare for the following classes. In the '3rd class', the teacher reported difficulty in student interaction through Brainstorming. Thus, the professor needed to indicate the importance of greater student interaction, considering that the class was applied in a fully interactive environment, appropriate for Brainstorming, which should have facilitated the work of integrating the class. As Software Engineering students had not had previous contact with this type of active activity and did not know the proposal of the class, this can be considered a variable that influenced the difficulty of participation and involvement of these students.

According to the professor's report, the '4th class' occurred as planned, with no difficulties from the students in accessing and producing narratives using the technological tools. In the '5th class', the collaborative virtual space was used, where the students were able to share and build knowledge through the construction of the group project – the activity took place without difficulties, as the students were used to this space.

Then, in the '6th Class', the teacher followed the planned proposal, obtaining the expected result. This demonstrates it is not the format of the classes, face-to-face or online, that leads them to reach their objective, but rather the proper use of planned strategies; which allow adaptation when necessary.

In the '7th class', the teacher reported the need for intervention with the students to reinforce the importance of dedication and commitment in carrying out the activities, requiring correction of the delivered work and realignment of the activity proposal. Therefore, the '8th class' resulted in significant feedback, as the teacher requested them to redo the previous activity, which was insufficient, and encourage the students to discuss again using a technological tool.

Finally, the learning review proposed for the '9th class' was applied by the professor through classroom discussion and delivery of activities, with no need to prepare the concept map, which serves as feedback on the nine applied classes. This class was assessed as positive, as the students not only understood the proposal of the Flipped Classroom but also managed to apprehend specific knowledge of the subject in a differentiated and interactive way.

The analysis of class records and the unstructured interview with the professor showed that many of the performed activities contemplated the concepts of PBL and OMP, strategies which are not traditionally used as sequenced in class planning. Nevertheless, the PBL and OMP strategies were used in the context of the Flipped Classroom, as the developed activities focused on a problem pre-established by the professor, followed by the development of systematized actions to bring a solution to the identified problems.

Final considerations

The descriptive scenario of the class structuring and systematization reveals a sequence of classes designed from the perspective of active methodologies and in the process of applying the Flipped Classroom, as shown in the research by Fiorini (2019) and the theoretical descriptions of active classes. The conduction of this profile of activities which require the student to undergo a previous organization and preparation process to be in the classroom constitutes a challenge for the teacher. This is because adaptations were necessary for some classes to better frame the curricular contents of the course and adapt to the pedagogical strategies adopted in the Flipped Classroom.

To contemplate the PBL and OMP strategies, the developed pedagogical planning had an impact on the conduction of classes which presented a sequence similar to the sequence of PBL classes in relation to survey the problem and the execution of the project for problem-solving in OMP. It is believed that the professional and academic training in the Exact Area allowed for an understanding of the class planning and the systematization of actions. Another important factor to highlight, in the application of classes in the Software Engineering course, was the familiarity of this profile of students with the use of information technology tools. This familiarity served as a motivational resource for students.

The research verified that, to carry out the class planning, the professor needs to think about the class sequence offered from the perspective of understanding the Flipped Classroom, about its elaboration and the importance in the teaching-learning process and in the students' training, as well as in the articulation of content/methodology in the development of pedagogical practice. With this, the professor can think of new actions to be added in the initial sequence of classes, triggering activities that provided opportunities for reflection on the practice of planning.

It is noteworthy that the professor's self-assessment process and the analysis of each class belong to the scenario of application of active methodologies. Carrying out an analysis of the students' engagement and

performance regarding the activities and what was proposed is necessary. The development of active methodologies requires continuous monitoring and assessment of each stage of planning per applied class so that the content and moments experienced are linked to the student's learning process.

Therefore, discussions that promote students' recognition and understanding about what the Flipped Classroom is should take place in initial classes, as well as the students' skills and abilities necessary for developing their learning in the specific teaching and learning process involving such methodology. That is, it is necessary to give the students more time to become familiar with the Flipped Classroom strategies, understanding and recognizing their active role in this type of methodology. The students should be aware that they need to have greater dedication, especially in online activities, as they are mostly individual ones. The activities demand time to study at home and the student needs better organization and conception about their learning. The professors also need to intervene with their students during the face-to-face classes, encouraging them in classroom discussions, motivating the exchange of ideas, and assessing the process under development and organization.

Validating this lesson planning in other areas of knowledge, such as the Humanities area, is suggested. For the continuation of this proposal, an investigation of new studies on the theme Flipped classroom with PBL and OMP with the use of knowledge management practices and tools is suggested to refine this proposal or even generate new models in the educational area.

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