

## Adoption of the moodle by university teachers in the actor-network theory perspective

*Adoção do moodle por professores universitários na perspectiva da teoria ator-rede*

*Adopción de moodle por profesores universitarios desde la perspectiva de la teoría del actor-red*

Márcia Melo Bortolato<sup>2</sup> 

Dulce Márcia Cruz<sup>3</sup> 

**Abstract:** Many Higher Education Institutions have been adopting Moodle as a support for face-to-face teaching with reference to the pedagogical practices of Distance Education (DE). However, since the conditions of the DE differ from those of classroom teaching, the modes of appropriation of innovation also diverge. In order to know the conditions and to what extent the process of adoption of Moodle occurs, a longitudinal case study of five years was carried out at the Federal University of Santa Catarina (UFSC). The research had several instruments (questionnaires, interviews, observation of disciplines and analysis of institutional reports). Merging precepts and methodologies of actor-network theories and diffusion of innovations, it was possible to broaden the vision of the paths traveled by the actants and to reach conclusions that Moodle is being used by the teachers who adopted the platform. However, the vast majority do not use their resources to extend classroom learning before, during and after the face-to-face meeting.

**Keywords:** Sociotechnical networks. Actor-network theory - ANT. Pedagogical practices.

**Resumo:** Muitas Instituições de Ensino Superior vêm adotando o Moodle como apoio ao ensino presencial tendo como referência as práticas pedagógicas da Educação a Distância (EaD). Contudo, como as condições da EaD diferem das do ensino presencial, os modos de apropriação da inovação também divergem. Para conhecer as condições e em que medida ocorre o processo de adoção do Moodle foi realizado um estudo de caso longitudinal de cinco anos na Universidade Federal de Santa Catarina (UFSC). A pesquisa contou com variados instrumentos (questionários, entrevistas, observação de disciplinas e análise de relatórios institucionais). Mesclando preceitos e metodologias das teorias ator-rede e difusão de inovações conseguiu-se ampliar a visão dos caminhos percorridos pelos actantes e chegar à conclusão que o Moodle vem sendo usado pelos professores adotantes. No entanto, a grande maioria não usa os seus recursos para estender as aprendizagens da sala de aula para antes, durante e depois do encontro presencial.

**Palavras-chave:** Redes sociotécnicas. Teoria ator-rede – ANT. Práticas pedagógicas.

**Resumen:** Muchas Instituciones de la Enseñanza Superior vienen adoptando Moodle como apoyo a la enseñanza presencial teniendo como referencia las prácticas pedagógicas de la Educación a Distancia (EaD). Sin embargo, como las condiciones de la EaD difieren de las de la enseñanza presencial, los modos de apropiación de la innovación también divergen. Para conocer las condiciones y en qué medida ocurre el proceso de adopción de Moodle se realizó un estudio de caso longitudinal de cinco años en la Universidad Federal de Santa Catarina (UFSC). La investigación contó con variados instrumentos (cuestionarios, entrevistas, observación de disciplinas y análisis de informes institucionales). Al fusionar preceptos y metodologías de las teorías de la red de actores y la difusión de innovaciones, fue posible ampliar la visión de los caminos tomados por los actores y llegar a la conclusión de que Moodle ha sido utilizado por los maestros

<sup>1</sup> **Submitted:** 01 Aug. 2018 - **Accepted:** 01 July 2019 - **Published:** 24 Dec. 2019

<sup>2</sup> Federal Institute of Education, Science and Technology of Santa Catarina (IFSC) – Email: marcia.melo.ead@gmail.com

<sup>3</sup> Federal University of Santa Catarina (UFSC) – Email: dulce.marcia@gmail.com

*adoptivos. Sin embargo, la gran mayoría no usa sus recursos para extender el aprendizajes de la sala de clase para antes, durante y después del encuentro presencial.*

**Palabras clave:** *Redes sociotécnicas. Teoría del actor-red - ANT. Prácticas pedagógicas.*

## Introduction

The growing process of digital media diffusion in Brazilian society, which has been consuming new devices and creating virtual habits and practices voraciously, has been manifest. However, in the educational system the speed has been different. To encourage the adoption of innovations, the Brazilian government has created projects in the last three decades such as “National Educational Technology Program” (*Programa Nacional de Tecnologia Educacional - ProInfo*), “One computer per student” (*Programa um computador por aluno - PROUCA*), “Broadband in schools” (*Programa Banda Larga nas Escolas - PBLE*), Integrated ProInfo, among others, aimed at guiding and training educators for the inclusion of digital technologies in pedagogical practices. Such initiatives have been successful in creating a perception that to improve teaching it is necessary to integrate media into the classroom, to the extent that, according to the International Research on Teaching and Learning (TALIS) (OCDE, 2013), 27% of teachers in Brazil said they needed training in the area of educational technologies, while the average for the countries participating in the survey it was 19%.

At the same time, this demand reflects teachers' perception of the need for literacy to adapt to the changing reality, but it also serves as a thermometer for perceiving the pressure on society, whether through media campaigns, governmental discourse or demand for accountability for the widespread educational crisis that seems to be increasing rather than decreasing every day (TANAKA, 2015, p. 1).

On the other hand, the adoption of virtual environments has been highlighted in both distance education and classroom teaching. Among the various programs developed or adopted by Brazilian universities, Moodle has occupied a prominent space among the most widespread digital media in higher education virtualization, as it is a virtual platform that can be integrated into educational processes in different ways. Available in the form of free, free, intuitive, easy-to-use and customizer software that can give rise to both a single teacher/trainer page and a university with tens of thousands of students/users.

Moodle (modular object-oriented dynamic learning) is a program developed by a worldwide community of developers. In Brazil, it became popular mainly for being adopted by the Open University of Brazil (UAB, acronym in Portuguese), since its beginning in 2007, as a management system (or platform) for creating online/distance courses. Gradually, it has also been adopted as a support for classroom teaching at UAB consortium or others, as a repository for teaching materials or as a virtual teaching and learning environment (AVEA, acronym in Portuguese). When planned as a repository, Moodle allows you to provide content, notices, and some resource for tutorial-style help. When thought of as AVEA, it should aim to build knowledge supported by interactions promoted by teachers and students, provide access to didactic content, learning activities and open spaces for discussion.

An AVEA allows the teacher to make the didactic materials available in advance, allowing the extension of discussions, productions and learning in the classroom before, during and after the presential meeting. In addition, it democratizes participation, since everyone, on equal terms, can manifest themselves in AVEA with their reflections or doubts, without having to compete for attention in a limited moment of the face-to-face meeting. (BORTOLATO, 2016)

Used as AVEA in distance education (DE), Moodle has revealed numerous possibilities for innovative pedagogical practices, with the availability of media materials, effective synchronous and asynchronous communication processes, possibilities for collaborative work between students with the help of the teacher supporting the collective construction of knowledge. These DE practices have been successful references for classroom teaching (MANO; CRUZ, 2016) and have been the object of research on their effects on the teaching-learning process focusing on students, teachers and even the performance of the technical device, i.e., the platform itself. However, the analysis of the research conducted on this theme revealed the researchers' frustration, because the experiences developed in DE cannot be replicated in classroom teaching.

In research conducted with teachers from the Federal University of Santa Catarina, Martins (2012) concluded that they used Moodle as a file management platform, prioritizing the storage of contents and the organization of teaching work and not as a virtual space for formative and pedagogical practices. According to Alves and Brito (2005, p. 9),

Discussing the presence of technological elements in contemporary society is a sine-qua-non condition. To think of them as mediating elements of pedagogical practice is our great challenge, since the interaction with these supports should be a basic condition for the process of teacher education, either at the initial or continuing level, thus contributing to a significant improvement of these teachers' pedagogical praxis.

The alleged inadequacy and ignorance of the teacher is part of the process of adopting innovation, which is influenced by many factors. Among these factors, we can mention the differences in the teachers' profile regarding the use of digital media in their social life and professional practice; availability and quality of the training processes of each institution; specific knowledge regarding Moodle resources; availability and incentives to use their work time and even their social time<sup>1</sup> to develop virtual tasks, among others. In this sense, the adoption of Moodle would bring challenges to the university by implying an innovation process with the potential not only to modify routines, practices and structures that had not been created to accommodate the characteristics and demands of the semi-presence modality, but, above all, the teaching culture of the classroom teaching.

Due to this complexity, the innovation process using Moodle in classroom teaching is not yet fully understood, in particular in the way they have been happening in pedagogical practices from the perception of the teachers that have adopted them. In this sense, some questions may be raised: who are those involved in the process within the educational institution and what do they think? What can be known about innovation by studying what teachers say and what teachers do in their innovative actions?

In this context, the main objective of this research was to investigate whether there was a sociotechnical network for the diffusion of Moodle innovation in classroom teaching and how to create strategies that would accompany and describe it in its active elements. We also wanted to know whether the adoption of Moodle in classroom teaching would have innovated pedagogical practices, how teachers experienced possible changes and what their actions related to innovation were. To achieve these objectives, a doctoral research (BORTOLATO, 2016) was conducted at the Federal University of Santa Catarina (UFSC), aiming to reveal the flows, controversies, effective and ineffective strategies of the process of Moodle adoption in classroom teaching. The study of different moments and approaches over five years has resulted in a large amount of qualitative and quantitative data. The theoretical-methodological option to analyze the complexity of those data was to merge some aspects of the Diffusion of Innovations Theory (DIT) with the perspective of the sociotechnical analysis based on the Actor-Network Theory (ANT).

The justification for this approach is that it allows investigating the phenomenon of innovation represented by Moodle in classroom education from the trails left by the teachers investigated and their perceptions on the process experienced. Thus, the DIT and ANT theories could be used in a complementary way (despite their differences) to try to broaden the researcher's view on the object of study, moving away from the ethnographic survey works and giving space for the object to focus the process of research on itself.

According to Pinto and Domenico (2014, p. 4, ), the approach advocated by the ANT asks the researcher to chant “a ‘Latourian mantra’ of ‘following the actors’”. And so we did, and by chanting the Latourian mantra, we followed the trails left by the teachers, our investigated actants, in their relationship with Moodle, another monitored actant. With their guidance, we went here and there, back and forth in the network flows, following their footsteps like ants when building their anthill.

The following is a summary of the theoretical and methodological foundations of ANT and DIT and what was set apart to be used in the present research.

## **ANT and DIT theories**

Latour's (2012) *Actor-Network Theory* (ANT) makes it possible to research “objects” (tokens) from the perspective of networks, observing their flows and their dynamics of construction and deconstruction. It understands that there is not a single center, but rather nodes that are creating new meshes and expanding the network. In the network we have mediators who play an active role in recruiting allies through translations that influence decisions and coexist in the pursuit of information. Their actions result in the formation of social groups that support the network by integrating more and more intermediaries - those who carry meanings without transforming them.

According to Latour (2012, p. 55), to delineate a group, create it out of nothing, or simply restore it, there is a need for spokespersons who “speak for the group's existence”. Therefore, one way to locate groups is to identify their spokespersons. All elements of the

network (humans and nonhumans) are considered actants and defined from their actions, at a given moment, as mediators or intermediaries.

According to Latour (2001, p. 91): “to know is not only to explore, but to be able to retrace one's steps, following the demarcated path”. To this end, Pedro (2008) suggests four basic steps for observation: (1) look for a gateway; (2) identify spokespersons; (3) access enrollment devices; and (4) map network connections. From the perspective of the ANT, the observation should be detailed, without haste, attentive to any detail. Never focused on a static object. It is the movements that brought the object to its current configuration, that is, what matters is the flows, the negotiations, following the path that has been traced and never tracing the path to follow it.

The second theory behind the research was Rogers' (2003) Diffusion of Innovations Theory - DIT, for which an innovation is first adopted by a small group of people who are the innovators (2.5% of the universe investigated), more willing to take risks. Then come the early adopters (12.5%), who are often part of the innovators' social circle and informed of the innovation by them. Both groups embrace innovations quickly. They are very important for the innovation process to spread, they are considered opinion makers. Following, there are potential adopters, the early majority (34%), who only embrace innovation after a varying degree of time, rarely occupy leadership positions in a system. The skeptical or late majority (34%) wait for innovation to be widely tested before risking using it. And finally, we have the laggards (16%), who are very reluctant to change, usually tend to focus on “traditions”, with some never adopting it.

For DIT, adopting innovations happens as a five-step process: (1) knowledge; (2) persuasion; (3) decision; (4) implementation; and (5) confirmation. The user of innovation can abandon the process at any stage. The persuasive power of opinion leaders and change agents greatly influences the adherence rates.

From these two views, we observe the flows teachers built at UFSC institution to adopt Moodle in their pedagogical practices, seeking to identify mediators, intermediaries, spokespersons, and also the innovators, early adopters and laggards. Mediators, intermediaries, and spokespersons are concepts of character classification within the Actor-Network Theory (ANT), and innovators, early adopters, and laggards are part of the Diffusion of Innovations Theory (DIT). We analyze the nature of groups, actions, objects and facts, as well as the stages of the process of adoption and the characteristics of the innovations perceived by the individuals that influence their decision.

## **The adoption of moodle at UFSC**

Moodle has been used at UFSC, since 2007, in distance education programs. In 2009 it was made available for classroom courses. Moodle UFSC operates synchronously with academic systems, so that the registration of the disciplines, classes, teachers and students is automatically done based on the data contained in these systems. During the semester it can

be used freely, and, in the end, grades managed in Moodle UFSC are transposed to the academic systems.

The quantitative growth of the use of Moodle for classroom courses at UFSC can be verified by the number of groups registered at the Academic Center of Graduation (CAGr), with teachers who used Moodle (going from 58% in 2012/1 to 71% in 2016/1). CAGr centralizes information about the graduation course, number of groups, number of students, grading, passing and failing. However, the usage data are insufficient to understand the way it has been adopted, that is, what pedagogical practices Moodle has been encouraging and which paths teachers have followed in their processes of adopting the innovation.

Latour (2012) uses a metaphor of ants and ant trails to refer to the actants and the imprints left by their actions during the process of building the network. The author makes a pun because his proposal for Actor-network Theory results in the acronym ANT. Using Latour's metaphor of the insect, we followed the ants' trails to see where they come from, how many they are, what they do along the way, which groups they belong to, what they are looking for and what they want to show. In order to visualize details of the ants' trail in the five years of investigation, we applied questionnaires to teachers and course coordinators, analyzed Moodle for some disciplines, interviewed teachers, and analyzed data from the teacher education processes of PROFOR (UFSC continuing teacher training program) and the actions developed by Superintendence of Information and Communication Technology (SeTIC) that influenced the formation of the socio-technical network studied. Here some of these data will be described and analyzed.

### *Following trails: group formation*

The data collection began with the observation of the trails left in the technological system of the institution from 2012 to 2013, where we found the highlight of the use of some teachers, “ants” who left stronger footsteps, standing out among the others. A 37 question questionnaire was prepared and sent to 434 teachers. From those, 75 teachers from different academic centers responded to their questionnaires. The main strategy to elaborate and analyze the questionnaire data was to identify the groups from the perspective of ANT and DIT. Each category of questions led us to profile differentiation and the answers made possible, concomitantly, the inclusion in distinct groups, as we will present below.

Latour (2012) recommends that before creating groups and investigating actants, we should consider that an actor can be framed in one of them and sometimes in more than one group. Actants move in and out of groups, so following trails can highlight such situations. Working in this perspective, categories of analysis of actants were created to define some groupings (following Latour's guidance: the key is to define the actor based on what they do - their performances) and to be able to compare group actions, verify similarities and differences between them, that is, the controversies<sup>ii</sup>.

The first groups created for analysis in the survey were distance versus face-to-face education, to distinguish members who had already worked in distance education and those

who had not had such experience. As counterpoint between the two groups, the researchers assessed their knowledge about Moodle, participation in specific training to use the platform, opinions regarding the training attended and where they seek knowledge or help to use it: from ANT perspective, the flows, influences, translations, mediators, intermediaries, change agents, opinion leaders. No major difference was identified between the two groups regarding their knowledge of Moodle, nor in the pursuit of knowledge.

There was a considerable distinction with regard to the training courses: most of the distance learning group stated that they sought something more instrumental, pragmatic and objective in the formations, while the presential group sought something more extensive with theoretical questions and didactic planning. These differences can be understood if we think that the group that has experience in distance education already had some knowledge of how to develop virtual activities didactically, wishing for their evolution to know more tools and resources available; on the other hand, the face-to-face group without experience with Moodle, wanted first the basic instrumental knowledge and, later, learn how to use these resources in a didactic way, thus expecting longer training courses that would allow such evolution.

New comparative groups were created, with their members defined from the time they used the computer daily, the “*Plugados*” (*plugged*, the ones who accessed the Internet more than eight hours a day), the “*Conectados*” (*connected*, six to eight hours), and “*Ligados*” (*switched on*, two to five hours). In this new group formation, we verified the answers related to personal media consumption, the meaning of the Internet in each one's life and the degree of difficulty in doing some basic tasks on the web - remembering that, from the DIT's perspective, we were looking for innovators, early adopters, potential (early majority) adopters, or late adopters (laggards). Although we found a group that stayed on the computer for two hours a day and another group more than eight hours, there were no significant differences between the personal consumption of each other. Therefore, we could not distinguish by the data of this group formation who the innovators, the early adopters, the potential adopters and the laggards were.

For this reason, new groups were defined, categorized as “*Autodidatas*” (*self-taught*, seeking knowledge only in tutorials), “*Parceiros*” (*partners*, seeking knowledge only with other teachers), “*Sem-fontes*” (*no-sources*, do not seek knowledge about Moodle in any of the options presented) and “*Multi-fontes*” (*multi-sources*, who have been trained at the institution and also drink from other sources). When comparing these groups, the frequency of the pedagogical uses of some media, which strategies and resources they used in classroom and the difficulties identified to adopt Moodle as an AVEA were analyzed. The level of knowledge of each resource available on the Moodle platform was also considered, and the adoption stages were analyzed according to the DIT: knowledge; persuasion; decision; implementation or confirmation. In this bias, some distinctions were observed between the groups, for example: “*Parceiros*” and “*Multi-fontes*” stated to have basic knowledge of Moodle, while “*Sem-fontes*” and “*Autodidatas*” considered themselves experienced. As for the knowledge of each feature available on the platform, the “*Sem-fontes*” did not confirm

being experienced, as they said that they did not use many of the features presented because they found it complex.

From the DIT perspective, we understand that “*Parceiros*” and “*Multi-fontes*” were in the phase of knowledge and/or persuasion. If we look at this configuration from the ANT perspective, we see these two groups as intermediaries (those who carry meanings without transforming them, who are influenced by mediators), who play an active role in recruiting allies through translations that influence decisions and coexist in the search for information.

### *Group analysis*

Some results are worth commenting in more detail from the group analysis. We noticed that most teachers had good mastery of media in their personal lives, often and easily used almost all the resources presented, and yet, for the vast majority (99.5%) of teachers the main didactic strategy were the lectures and resources, PowerPoint (88%) and text (75%), regardless of their group.

Although some excelled in the use of media, both in their personal lives and in their didactic use, they were few: only 4 out of the 75 respondents described themselves as experts in Moodle.

We could not verify in this first part of the study who the mediators, the intermediaries, or the opinion leaders or change agents were, although we followed several trails and analyzed the various groupings. We identified some flows and translations that permeated the adoption process, such as the exchange of knowledge between teachers, declared by 35% of respondents, and the contribution of training processes to use the platform, stated by 30% of teachers interviewed. We could say that in the group of teachers who exchanged information there were opinion leaders or mediators who conveyed the information and influenced decisions of embracing it. Similarly, in the process of formation we would have agents of change, but it would be a hasty conclusion and without evidence enough.

The truth is that following the group trails was important to get an overall view of the profiles, but the action did not identify the plots and connections clearly. Then, we selected some teachers whose profiles showed they used Moodle features the most, and requested permission to view the AVEA of their disciplines. Of the 20 teachers requested, 12 authorized. The AVEAs of the subject matters were analyzed based on some criteria and, among the analyzed ones, we interviewed five teachers, each from a different academic center, to get to know the actants closely to extract more information. In this new sample, the data from the profile constructed from the questionnaire answers, the AVEA analysis and the statements of each personal interview were crossed.

Although the sample was very small, less than 10% of the first, it was considered significant when considering the focus, as recommended by the ANT, unveiling issues not previously perceived, such as the difference in the network configuration between academic centers. For Latour (2012), the ANT can better glimpse order after letting the actors unfold



the full range of controversies they have gotten themselves into. It is as if the actors were told: “We are not going to try to discipline you, frame you into our categories; we will allow you to focus on your own worlds, and only then will we ask you to explain how you established them” (LATOURE, 2012, p. 44).

In the statements we heard and analyzed, different configurations appeared within the socio-technical network. In some academic centers, the dynamics were structured with active mediators and the translation took place (from the ANT perspective). From the DIT perspective, we realized that the diffusion process was developed by a group of innovators and early adopters. We perceived academic centers acting as network actors, considering that “a network of actors is simultaneously an actor, whose activity consists in bringing new elements into its network, constantly redefining and transforming it” (CARVALHO, 2007, p. 48). In other centers, the transformation (adoption of innovation) took place slowly, without the active action of mediators, presenting a slow process, or following the DIT “S” curve<sup>iii</sup>, still in the second stage, despite having already started five years ago.

According to Rogers (2003, p. 15), “many innovations take a long time, often many years, from the moment they become available until they are widely adopted”. We observed some controversies such as that of an actor who claimed to be an expert on Moodle but never took a course. Another controversy was that of a teacher who, despite being in a very propitious context, as he was part of the teacher training group, did not show any action as mediator, change agent or opinion leader.

This phase of the research was important because we perceived associations and negotiation processes that occur before a collective is constituted by the object/fact/characteristic that defines it as common to a collectivity, as or more important than the final result. In other words, “the closer we get, the more controversial things become” (LATOURE, 2000, p. 53).

To complete the route view, we returned to SeTIC to update the data collected in 2013 and confirm some issues perceived in the route from 2012 to 2016. First, we accessed the report of Moodle adoption by teachers in each semester of the period 2012/1 to 2016/2 per campuses. The analysis evidenced that the adoption of Moodle in the new campuses (*Araranguá, Blumenau, Joinville, Curitiba*) was much higher than in the central campuses and that, in those places, the few cases of teachers who were not using Moodle in the classroom occurred only in the first semester of their acting. Such data were confirmed in the report of Moodle classes in relation to the groups created in CAGr. The increase in adoption of Moodle was commensurate with the increase in class groups at the academic center, demonstrating a more accelerated adoption process in all academic centers.

This confirmed the existence of a well-structured socio-technical network, with mediators quickly and effectively translating the innovation adopted for every new campus member. The process was strongly instituted early in the activities of such campuses through spokespersons or opinion leaders, “a kind of informal leadership, capable of influencing the attitudes of other individuals or behaviors” (ROGERS, 2003, p. 388). We conclude that the cohesion of these networks may have occurred due to the favorable conditions found, with little resistance to the use of technological artifacts, for two reasons: because they appeared at

a time when digital culture was already prominent in society; and because those campuses have a strong performance in the areas of technology and engineering.

When checking how the evolution of Moodle adoption process in classroom courses at UFSC (of all centers) was, we found that, despite its constant increase, the adherence rates (average of 62% in the five years investigated) were much lower than those found in the new campuses (96%). For comparison, we verified the evolution of the adoption process in the Legal Sciences Center, which had presented the lowest adherence of teachers, confirming that it was also evolving because, despite its low rates (10% in 2012), the figures grew by 7% in the period studied (17% in 2016). The same happened in intermediate centers in the adoption process, such as the Physics and Mathematics Center, which grew 8% (from 48% in 2012 to 56% in 2016) and the Philosophy and Human Sciences Center, which grew 16% in this period (from 40% to 56%).

### *Non-Human analysis*

As the research was inspired by ANT, it would not be possible to disregard the possible non-human actants of the network. According to Latour (2012), the role of each actor is defined based on their performance in this universe, that is, how active and repercussive it is, how much effect it has on their network. Thus, it was necessary to analyze the role of UFSC in the network, through its managers, the course coordinators, as well as SeTIC and PROFOR. SeTIC, for being the technical responsible for Moodle UFSC in all its applications and PROFOR, for being an institutional agent responsible for training teachers to use Moodle.

Through the questionnaire responses, the course coordinators that participated in the sample could be divided in two profiles. Eight coordinators can be considered as intermediaries and two as mediators. The intermediaries considered that the difficulties encountered by their course teachers for greater use of digital resources in the classroom were due to the lack of knowledge about the possibilities of using digital resources. The mediators stated that the training provided to teachers was the department's and/or coordination's exclusive initiative. All the coordinators considered that Moodle's high effectiveness rate in classroom courses was due to the teacher's own interest and not because of the institution's requirement; because of the students' interest and demand (50%) and because of some innovative teachers' encouragement by sharing their findings and satisfaction with its use (40%).

Therefore, according to this analysis, a strong persuasive action of the institution in the representation of its coordinators could not be verified. They (80%) saw Moodle as a virtual tool that could be used to support classroom teaching and stated (80%) that in their course there was a strong use of the platform as a content repository for posting the texts worked in the classroom. The fact that two coordinators are considered as mediators owes more to the fact that they lead departments that provided training courses for their teachers, than to their direct persuasive action. Centers that had a well-structured network and a

growing process of adopting Moodle in face-to-face teaching were observed. In one of those, almost 100% of the teachers used Moodle and, according to the response of the teacher in this center, the influence of mediators and opinion leaders was noticed.

Another actant found on the network was SeTIC, the technical responsible for Moodle UFSC in all its applications (DE, classroom teaching, extension) and for the development of tutorials available on the platform and updating of new versions. SeTIC supported users with a Frequently Asked Questions and Answers (FAQ) organized by general topics, student and teacher questions as well as an online call system for questions and technical support, feeding a database on Moodle's uses at UFSC and generating several follow-up reports for the institution and researchers, which greatly helped us in the research.

An important actant in the network, due to the generation of innovation in this research universe, many of its actions were directed to translation (tutorials), from the ANT perspective, but could also be considered as an agent of change, as it influences the adhesion rate, from the DIT perspective, since many users could give up on using it if they didn't have information and immediate help available just a few simple clicks away directly on Moodle UFSC. That is the reason we could perceive it as a mediating agent within the socio-technical network.

PROFOR was the institution's responsible for training teachers to use Moodle. For ANT, a network of actors is simultaneously an actor whose activity is to bring new elements into its network, constantly redefining and transforming it. Therefore, we can consider PROFOR as an actant on the network, a non-human actor. The course lecturers, acting on behalf of the Institution/PROFOR, shared their knowledge and, at the same time, involved and mobilized allies for the network. According to Latour, "to delineate a group, whether it is necessary to create it out of nothing or simply restore it, there must be spokespersons that speak for the group's existence" (LATOURE, 2012, p. 55), and PROFOR "was" the spokesperson with their course lecturers (or change agents and opinion leaders, from the DIT perspective). Moodle training courses promoted the translation.

The presence of PROFOR in the network was very significant, especially at the beginning of the availability of Moodle for the classroom courses, to the extent that, in the first three years (2009-2011), 54 training courses were developed. However, non-humans, "by the very nature of their ties with humans, soon cease to be mediators to become intermediaries" (LATOURE, 2012, p. 109). This may justify the decrease in training in the last three years of the research (2014-2016), in which only eight courses focusing on the use of Moodle were offered. Thus, PROFOR ceased to be a mediator to assume the role of intermediary.

## Final comments

In this research, in the light of the theories, we understood that the socio-technical network formed for the adoption of Moodle innovation in classroom courses at UFSC had its particularities for each academic center. Some centers had the important figure of the

translator (spokespersons, mediators, change agents or opinion leaders) and so the process of diffusion of innovation was accelerated and was configured at the end of the research in the closing phase of the black box, “stabilization or solidification” of a situation (from the ANT perspective), or in the last phase of the “S curve” (from the DIT perspective), since they reached almost all members that adopted the studied innovation.

Other centers adopted it slowly but steadily, but it seemed to be much more due to the demand of the digital culture than to the internal influence of mediators or agents of change. Nor can we disregard that the process of innovation in the oldest and most traditional UFSC centers faced tough barriers, such as the embedding of a traditional education perpetuated for over half a century of existence.

We have observed in our trajectory how Moodle has been adopted by teachers. We have proved that the situation revealed in previous research remained the same until the final moment of our research. UFSC teachers who used Moodle in face-to-face teaching, regardless of whether they belonged to a traditional center or a new center, did not meet the requirements to characterize it as an AVEA.

The centers in particular and UFSC in general presented file posting as well as task delivery and forums as the most used features. Even though it seems incongruous, forums cannot be considered a discussion feature because automatically all subject matters have a news forum, exclusive for teacher notices (unidirectional communication), that cannot be deleted and that were counted in the report data. Therefore, this data is not so encouraging.

The objective of our research, which sought to answer the question of whether there was a socio-technical network for the diffusion of Moodle innovation at UFSC classroom teaching at UFSC, was answered positively, as we were able to identify it.

The next question (whether the adoption of Moodle in face-to-face teaching would have innovated pedagogical practices and if so, how teachers experienced such a change) had as answer that the innovations were not as many as we assumed, since most teachers used Moodle more for logistical support for delivery and receipt and sending notices. We observed few cases where they developed teaching-learning activities, configured as AVEA. But we also found some innovators, presenting assertive strategies, who, with their example, can become agents of change. We realize that the few who turned Moodle into AVEA and thereby innovated their pedagogical practices, accepted the change in a very optimistic and encouraging way, emphasizing in their lines the perceived advantages.

For the question of what teachers needed to innovate, our research showed that there is a need for translators. The translators (mediators, spokespersons, opinion leaders, change agents) were already working in the studied context, but what seemed to be lacking were the communication channels, which, according to DIT, are a key element for the diffusion of innovation to happen. Communication channels could be created strategically, in pedagogical meetings, training moments, didactic planning etc., that is, with the creation of possibilities of flow for the information that was being created by some of the innovators. In this sense, we can only identify the work of PROFOR through the training strategies.

Finally, this paper sought to expose the potential of the association of ANT and DIT

theories for the analysis of large amounts of data in research focusing on the diffusion of innovations. Our results indicate a symmetry between success and failure of the process of diffusion of innovations and should be considered relevant, therefore, worthy of investigation in detail, together with the perspective of socio-technical networks, both for development and for closure of the investment in a given innovation.

## References

ALVES, Lynn Rosalina Gama; BRITO, Mário Sérgio da Silva. O Ambiente Moodle como Apoio ao Ensino Presencial. *In: 12º Congresso Internacional de Educação a Distância*. Florianópolis, 2005.

BORTOLATO, Márcia Melo. **Inovação e práticas pedagógicas: o moodle no ensino presencial da Universidade Federal de Santa Catarina**. 2016. 290 f. Tese (Doutorado em Educação) - Universidade Federal de Santa Catarina, Florianópolis, 2016.

CARVALHO Ingrid Aline de. **A rede sociotécnica na formação de professores de ciências da natureza, matemática e suas tecnologias/física**. 2007. 169 f. Dissertação (Mestrado em Educação Científica e Tecnológica) - Universidade Federal de Santa Catarina, Florianópolis, 2007.

KENSKI, Vani Moreira. **Tecnologias e Tempo Docente**. 1 ed. São Paulo: Papiru, 2013.

LATOUR, Bruno. **A Esperança de Pandora**. Bauru, SP: EDUSC, 2001.

LATOUR, Bruno. **Ciência em ação: como seguir cientistas e engenheiros sociedade afora**. São Paulo: Editora UNESP, 2000.

LATOUR, Bruno. **Reagregando o Social**. Uma introdução à teoria do ator-rede. Salvador: EDUFBA, 2012; Bauru: EDUSC, 2012.

MANO, Marina Lemos Carcereri; CRUZ, Dulce Márcia. As práticas e linguagens da cultura digital na educação: uso do *Moodle* e letramento midiático de professores de uma universidade pública. **RENOTE - Revista Novas Tecnologias na Educação**. Porto Alegre, v. 14, n. 1, p. 1-10, jul. 2016.

MARTINS, Aline Santana. **Um olhar sobre as mídias em práticas pedagógicas na didática universitária**. 2012. 194 f. Dissertação (Mestrado em Educação) - Programa de Pós-Graduação em Educação, Universidade Federal de Santa Catarina, Florianópolis, 2012.

NOBRE, Júlio Cesar de Almeida; PEDRO, Rosa Maria Leite Ribeiro. Reflexões sobre possibilidades metodológicas da Teoria Ator-Rede. **Cadernos UniFOA**. Volta Redonda, n. 14, p. 47-56, dez. 2010.

OCDE. Organização para Cooperação e Desenvolvimento Econômico. **Pesquisa Internacional sobre Ensino e Aprendizagem (TALIS)**. OCDE: França, 2013.

PEDRO, Rosa Maria Leite Ribeiro. Redes e Controvérsias: ferramentas para uma cartografia da dinâmica psicossocial. *In: VII ESOCITE - Jornadas Latino-Americanas de Estudos Sociais das Ciências e das Tecnologias*. Rio de Janeiro, 2008. **Anais...** Rio de Janeiro, 2008.

PINTO, Clovis Cerretto; DOMENICO, Silvia Marcia Russi de. Teoria ator-rede em estudos organizacionais: encontrando caminhos via cartografia de controvérsias. *In: VIII Encontro de Estudos Organizacionais da ANPAD*. Gramado, RS, 2014.

ROGERS, Everett. **Diffusion of innovations**. New York: Free Press, 2003.

TANAKA, Eliane. Professor: as dificuldades para utilizar a tecnologia dentro da sala de aula das escolas públicas brasileiras. **NIC.br** - Núcleo de Informação e Coordenação do Ponto BR. 29 jul. 2015.

## Notes

<sup>i</sup> According to Kenski (2013), teaching time is the hours hired and paid by the educational institution in which the teacher works. Social time includes the hours the teacher works at home, in their free time, which is no longer used for socializing in favor of attending students at AVEA.

<sup>ii</sup> The term controversy refers to a dispute in which reasons are argued for or against, in which movements whose unfolding will be the achievement of a common goal can be evidenced. (NOBRE; PEDRO, 2010).

<sup>iii</sup> According to studies by Rogers (2003, p. 23), the result of adopters' behavior analysis is explained in the adoption rate, which is "the relative speed with which an innovation is adopted by members of a social system". Adoption has an average time pattern for each adopter that can be represented by an S-shaped curve.

