A Distance Learning Pedagogical Management Model based on Affinity Networks

Un modelo de gestión pedagógica a distancia basado en Affinity Networks

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Abstract

Using affinity networks as its basis, this study proposes a management model of distance learning (DL) professional training courses as a space conducive to knowledge diffusion, on the basis of the technological profile of course participants. The proposed model uses individual metrics of each actor in the network, the technological profile (TP) of the participants and a diagram of activities used for the actions taken during the pedagogical management of a distance learning course. This is an instrumental case study whose research method is strongly influenced by netnography. The data were collected from participants in two editions of a Brazilian support programme for municipal education leaders. The proposed model defines collective and individual management strategies and contributes to the management of education focusing on the success of the learning process in a virtual learning environment by incorporating the

TP of subjects involved in distance learning courses.

KEYWORDS
Distance learning, technological profile, affinity, social networks, virtual learning environment.

Resumen

Este estudio propone un modelo de gestión de los cursos de formación profesional de aprendizaje a distancia (DL) utilizando redes de afinidad como base y como un espacio propicio para la difusión del conocimiento, a partir del perfil tecnológico de los participantes del curso. El modelo propuesto utiliza métricas individuales de cada actor en la red, el perfil tecnológico (TP) de los participantes y un diagrama de las actividades utilizadas para las acciones tomadas durante la gestión pedagógica de un curso de aprendizaje a distancia. Este es un estudio de caso instrumental cuyo método de investigación fue influenciado por la netnografía. Los datos fueron recolectados de los participantes en dos ediciones de un programa brasileño de apoyo para líderes de educación municipal. El modelo propuesto define las estrategias de gestión colectiva e individual y contribuye a la gestión de la educación centrada en el éxito del proceso de aprendizaje en un entorno de aprendizaje virtual mediante la incorporación del TP de los sujetos implicados en los cursos a distancia.

PALABRAS CLAVE

Aprendizaje a distancia, perfil tecnológico, afinidad, redes sociales, entornos de aprendizaje virtual.

1. INTRODUCTION

It is recognized that in recent years, the management of distance learning has progressed in Brazil and worldwide, but there is more to be done. The regulatory of the process for monitoring student learning, teacher qualification and training geared specifically to this type of education, and the methods used are some examples of research areas that still offer opportunity for new studies, including studies that seek to apply concepts from other areas (e.g., computing and administration) to education.

The development of DL courses faces major challenges, including resource limitations (e.g., inadequacies in technol- ogy infrastructure, limited availability of student time, little experience of teachers in this modality). Thus, incorporating decisions made by company managers may be beneficial because managers, when confronted with limited resources but great demand, seek through diagnosis and understanding of the structure they possess to define the starting point to carry out a plan of activities.

Based on a belief that professional education is possible through DL, and considering as a central axiom that knowledge construction and learning can take place in a Virtual Learning Environment (VLE) for professional education, the guiding question of this study is: How can a pedagogical management model that favors the diffusion of knowledge in DL courses based on the technological profile and the affinity among the course's participants be established?

Accepting that technology enables new knowledge and that the student is at the center of the DL process, we sought to establish a model of pedagogical management of courses centered on the course participants' Technological Profile (TP) based on a diagnostic performed directly with the participants. In this study, we define TP as the minimal knowledge and abilities a user must have to take advantage of computing

resources, such as word processors, spreadsheets, Internet navigation, file downloading, and emailing. The proposed model allows affinities to be identified based on the characteristics of the course participants and defining a set of management strategies from these characteristics.

One of the major contributions of this study is the defense of the incorporation of the TP of course participants involved in studies that seek to examine knowledge diffusion in DL courses. For this purpose, the TP was used as a basis to define the affinity among the participants so that from this affinity a pedagogical management model favoring cooperation and diffusion of knowledge among participants in DL professional training courses taught via a VLE was proposed.

Another no less important contribution is that the use of computers (to make access to the course feasible in a virtual environment, enable individualized studies and establish collaborative interactions), as proposed in the model presented here, corroborates education management focused on the success of the learning process in a VLE.

2. THEORETICAL FOUNDATION

The theoretical framework of this study was organized based on the major theoretical areas (i.e., Netnography, Network Theory, Pedagogical Management and Distance Education) shown in Figure 1. Based on different forms of student interaction in distance learning courses, we decided to use network theory and netnography as theoretical- methodological support for the model proposed in the study. We then describe previous studies that have discussed pedagogical management with a focus on distance education.

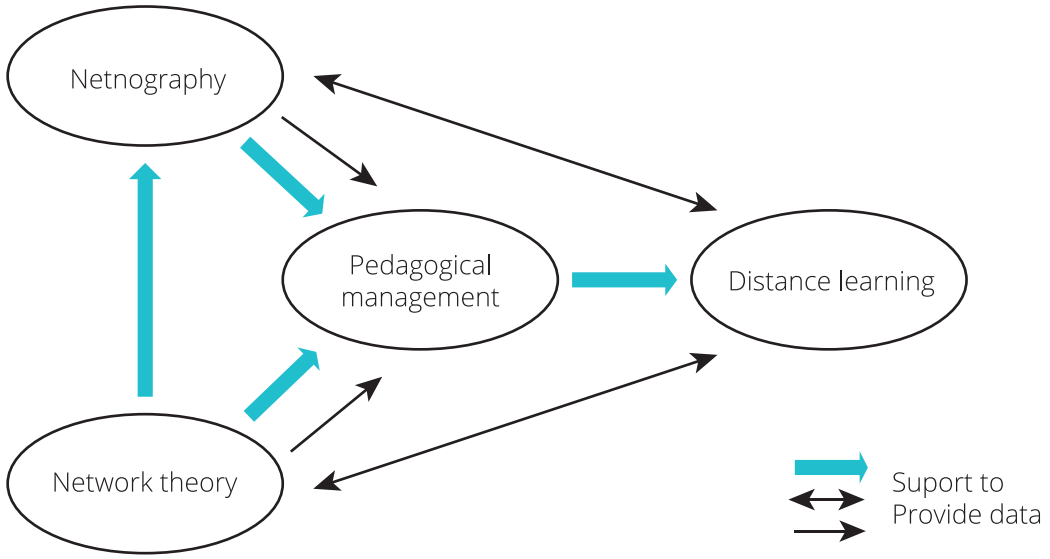

Figura 1. Theoretical framework of the research. Source: prepared by the authors.

For discussion about distance education and course management in this mode, the studies of Retamal (2009), Bicudo (2005), Cerny (2009), Araújo et al. 2013, Rumble (2003), Batisti et al. (2010), Silveira (2006) and the studies of Recuero (2009), Gebera and Washington (2008), Del Fresno (2011) discussion about network

Kozinets (2010, p. 9) describes netnography as "a specialized form of ethnography adapted to the specific contingencies of contemporary social worlds mediated by computers."

Regarding pedagogical management, Cerny (2009) highlights that this must be viewed as a set of conditions and as a means to enable teaching and learning in an articulated way that integrates actions and activities through planning, organization, follow-up and evaluation.

In this study, pedagogical management is defined as an extended management process that, based on the evaluation of the profile of students involved in a given course, allows establishing goals and strategies to foster collaboration in the teaching-learning process, in the development of appropriate pedagogical content, and in the adequate monitoring of the performance of students, teachers and school staff.

Santos and Ramos (2002) presented a roadmap for what they call eLearning on demand, a proposal that DL courses be defined and structured in a personalized way to help modify the current landscape of homogeneous education for a heterogeneous student population.

The aforementioned findings and reflections allowed us to form a model that uses (1) network theory and netnography to discuss relation patterns (2) and that uses these patterns to direct DE course strategies and management approaches. This model is in consonance with the arguments made by Kozinets (2010, p. 57), who states that "the use of social networks and netnography is appropriate for studies that seek to discuss patterns of relations or social links."

3. MATERIALS AND METHODS

This research is an instrumental case study strongly influenced by netnography (Ávarez, 2009 and Del Fresno, 2011 and Rozo and Peña, 2012). The case studied was a Brazilian support program for municipal education directors, hereafter called Pradime/EaD (Programa Brasileiro de Apoio aos Dirigentes Municipais de Educação - Educação a Distância [Brazilian Program for the Support of Municipal Education Directors - Distance Learning]). Recognizing the novelty of the study object, which uses social networking metrics as a tool to support the pedagogical management of professional training courses, the methodological approach developed here constitutes its own hybrid model, composed of netnographic and case-study elements (as a research instrument) in a qualitative and quantitative approach.

This study is based on an interpretive philosophical perspective because it opts for an interpretive design. From this perspective, the study seeks to understand the social context in which it was conducted.

To describe the model, it was necessary to show how aspects related to participant competencies and abilities can define an affinity network. Using these features as a starting point, we designed a model of affinity networks from the technological profile of the DE students (Figure 2). This affinity network will be used to define the pedagogical management model of the DE course.

Data were collected in four stages, through the direct administration of questionnaires to Pradime/EaD partici- pants to understand the participants' characteristics. Two questionnaires were administered during the Pradime/EaD 2010 course: one at the beginning of the course (stage 1) and the other at the end (stage 2).

In the 2012 edition of the Pradime/EaD course, an identical procedure was followed, with the administration of the same questionnaires used in the 2010 edition of the course (stages 3 and 4).

The study was conducted in a Brazilian state during the two editions of the Pradime/EaD course, and the study subjects were participants in this course. In 2010, the participants were Municipal Education Directors (MED). In the 2012 edition, a vacancy was opened for a certified technician from the Municipal Department of Education. Thus, two individuals from each municipality participated in the course.

Because it involved human beings, this study was submitted to and approved by the Ethics Committee of the State University of Feira de Santana (Universidade Estadual de Feira de Santana) under CAAE no. 07375312.4.0000.0053.

Based on Almeida's (2003) definition of a student's TP in a DL system, it was possible to construct an indicator that characterized the TP of the Pradime/EaD course participants. The indicator developed is a weighted average, in which each participant's particular representation is determined by his or her attributes. These attributes define the participant's aptitude level in using the tools necessary to take advantage of a DL course.

Four profiles were established according to this indicator: Low, Low-Medium, Medium and High. Values between 0.00 and 1.49 indicate Low TP, between 1.50 and 2.00 Low- Medium TP, between 2.1 and 2.5 Medium TP and between 2.6 and 3.0 High TP.

The calculation of the TP does not consider other factors that contribute to success in this type of course, such as the programmatic content or design of the environment, because the focus of this characteristic is the subject who participates in the course. Moreover, there are few studies that use affinity networks of course participants as proposals for course manage-

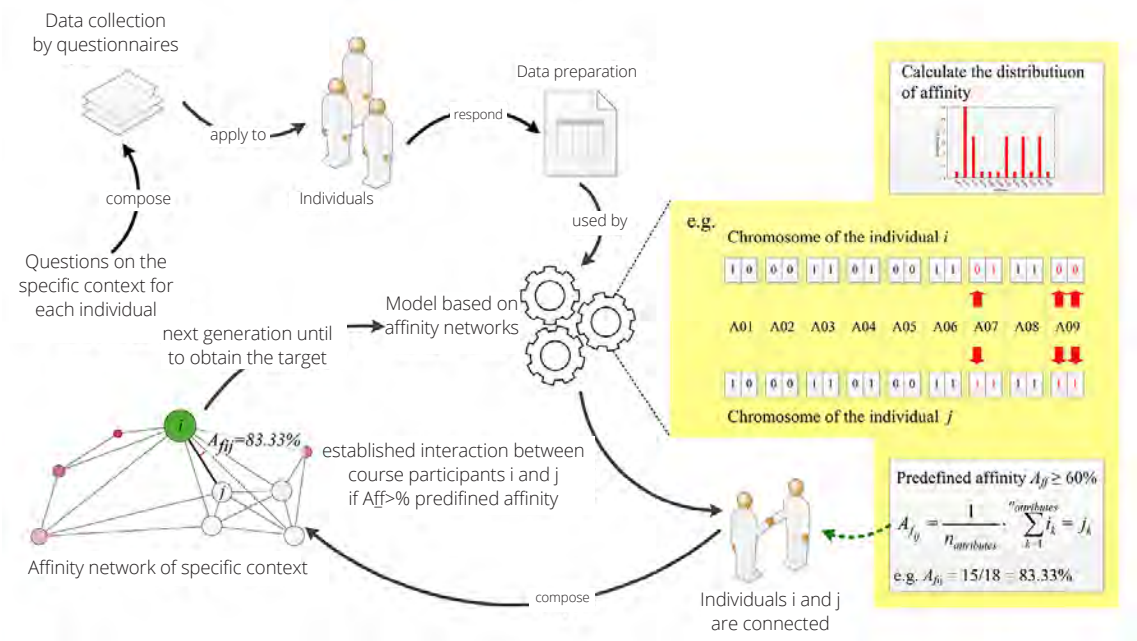

Figura 2. Affinity network model based on the technological profile. Source: prepared by the authors.

ment. Consequently, we could not find comparative references. The studies that do exist examine the impact of low digital knowledge and its consequences for the development of DL courses.

In this way, some of us formulated a method to construct and simulate networks using as the criterion the affinity between individuals/actors in a social network (Monteiro et al., 2014). In this type of network, two actors would establish a relationship if they had a minimum number of similarities between their attributes. The similarity can be defined in terms of any set of actor attributes (e.g., cultural preferences or consumption patterns). That is, based on a minimum similarity between the attributes of two actors, it is possible to determine their affinity and thereby build networks on the basis of these affinities. The affinity between two individuals, i and j, is defined by Equation 1:

where nattibutes is the number of characteristics considered to determine affinity, i and j are two individuals (vertices) and k is the k-th attribute of each individual.

Because the variables that make up TP are attributes, we used the model proposed by Monteiro et al. (2014) to generate the affinity networ-

$$A_{f_{ij}} = \frac{1}{n_{\text{attributes}}} \sum_{k=1}^{n_{\text{attributes}}} i_k = j_k \qquad (1)$$

ks between the Pradime/EaD participants in a Brazilian state. For this purpose, we compared the similarity of the participants' questionnaire responses because this similarity would identify an affinity between them.

Ten social networks were generated for each edition of the Pradime/EaD (2010 and 2012), taking into account degrees of affinity ranging from 10-90% in the responses. To perform these calculations, the software Index to Evaluate the Genetic Fitness of an Individual - IEGFTOOLS (Carneiro et al., 2013) was developed.

Data from the networks showed that the best option was to consider the network with 60% affinity (in both 2010 and in 2012) because this was the largest affinity value that still produced a network with vertices connected to at least one other vertex (Tables 1 and 2). With this data, we can assert that a minimum interaction exists.

After generating the affinity networks and determining which would be used for the model, the next step is to calculate and evaluate the metrics of the actors/participants in the chosen network. Because the measures of centrality indicate the importance of a vertex, or actor, in relation to the other actors in the network (Freeman 1978-79), we opted to work with this metric. Three measures of centrality are most commonly used in the analysis of social networks: degree centrality, betweenness centrality and closeness centrality. We worked with betweenness centrality because it helps better identify the participants who act as intermediaries within the network because it identifies the potential of the actors who serve as intermediaries. These actors are connectors and facilitate the flow of information in a network. This intermediary role implies an exercise of leadership and perhaps a controlling role in this process; therefore, this identification corresponds with the definition of the pedagogical management strategies that were established.

Table 1. Basic statistics to select the network of participants in the Pradime/EaD 2010 constructed from the affinity between variables that make up the TP.

Aff	n= |N|	m= |E|	Δ	(k)	C	min k	L	D	E(G)	Eloc
0.1	46	1035	1	45.00	1	45	1.00	1	1.00	1.00
0.2	46	1025	0.99	44.56	0.99	40	1.00	2	0.99	0.99
0.3	46	971	0.93	42.21	0.94	35	1.06	2	0.96	0.97
0.4	46	861	0.83	37.43	0.87	25	1.16	2	0.91	0.93
0.5	46	638	0.61	27.73	0.75	12	1.38	2	0.80	0.87
0.6	46	387	0.37	16.82	0.65	3	1.73	3	0.66	0.82
0.7	46	153	0.14	6.65	0.52	0	2.44	6	0.41	0.71
0.8	46	43	0.04	1.86	0.27	0	2.39	5	0.08	0.38
0.9	46	8	0.00	0.34	0.06	0	1	1	0.00	0.06

Legend: Aff - affinity, n = |N| - no. of vertices, m = |E| - no. of edges, Δ = density, (k) - average degree, C - average clustering coefficient, min k - minimum degree, L - average shortest path, D - diameter, E(G) - global efficiency, Eloc - local efficiency.

Table 2. Basic statistics to select the network of participants in the Pradime/EaD 2012 constructed from the affinity tween variables that make up the TP.

Aff	n= |N|	m= |E|	Δ	(k)	C	min k	L	D	E(G)	Eloc
0.1	68	2278	1	67.00	1	67	1.00	1	1.00	1.00
0.2	68	2254	0.99	66.29	0.99	56	1.01	2	0.99	1.00
0.3	68	2143	0.94	63.03	0.95	39	1.06	2	0.97	0.98
0.4	68	1844	0.81	54.24	0.87	17	1.19	2	0.90	0.93
0.5	68	1365	0.60	40.15	0.75	3	1.41	3	0.80	0.88
0.6	68	794	0.35	23.35	0.62	1	1.80	4	0.65	0.80
0.7	68	367	0.16	10.79	0.58	0	2.50	6	0.43	0.74
0.8	68	101	0.04	2.97	0.30	0	2.80	6	0.13	0.43
0.9	68	16	0.01	0.47	0.13	0	1	1	0.01	0.13

Legend: Aff - affinity, n = |N| - no. of vertices, m = |E| - no. of edges, Δ = density, (k) - average degree, C - average clustering coefficient, min k - minimum degree, L - average shortest path, D - diameter, E(G) - global efficiency, Eloc - local efficiency.

4. MODEL OF DISTANCE LEARNING PEDAGOGICAL MANAGEMENT

Considering the arguments presented, we propose a model of DL pedagogical management in three steps:

1. Diagnose student TP based on which affinity networks will be defined;
2. Apply pedagogical strategies according to students' TP that seeks to stimulate the creation and diffusion of knowledge;
3. Apply pedagogical strategies according to the affinity between the students to group students with greater affinity into specific groups.

The first step begins with the diagnosis, consisting of nine actions that should be performed

at the start of the course. We suggest that, at the time of enrollment, the students participate in a survey questionnaire to identify their TP. With this questionnaire as a foundation, the TP indicator is calculated for each student. Then, we extract the affinities between the participants from the questionnaire responses. Next, we perform network simulations with different affinity levels, ranging from a minimum of 10% to a maximum of 90%. Thus, we identify which affinity network exhibits adequate properties that make it possible to establish a more robust network based on the criteria defined by Monteiro et al. (2014). As discussed before, after the simulations, the network data indicated that the best option was to consider the network with 60% affinity (in both 2010 and in 2012).

Based on each participant's betweenness centrality, we identified the most prominent participants. From this identification, we propose the systemization of a ranking of participants in terms of importance of betweenness centrality.

The proposed model defines three scales based on a normal distribution, in which the intervals are classified as high, medium and low positions in relation to the ranking of the normalized betweenness centrality. The participants whose centrality is in the interval lower than the arithmetic mean ($C'B < \mu$) are classified as participants of lower importance in the ranking, the participants with betweenness centrality $\mu \leq C'B < \mu + \delta$ (where δ is the standard deviation) are classified as participants with medium importance in the ranking, and participants with centrality $C'B \geq \mu + \delta$ are classified as participants of high importance in the ranking. The diagnostic step based on the profile of the participants and the use of social network metrics is then completed (Figure 3).

In the second step, six management strategies organized based on encouraging collaboration and dissemination of knowledge during the course are proposed (Figure 4). Importantly, these strategies are not exclusionary. Because these strategies are geared to the course participants, they are called individual strategies (IS).

The first strategy (IS1) is communicating to the most important participants their importance in the affinity network, including presenting the network and their prominent positions. Critically, different participants will be supported differently during the course.

As the second strategy (IS2), we suggest paying special attention to the process of interaction of the most important participants in the discussion forums in the VLE. One can use individual messages sent directly to these participants to stimulate a greater contribution and/or submit a question directed to the participant in a discussion forum.

The third strategy (IS3) is directed to the participants with Low and Low-Medium TP who are important in terms of betweenness centrality in the network. These participants should receive even more differentiated treatment because of the influence that they can exercise in the diffusion of knowledge in the course's environment.

An important contribution of the proposed model is the possibility of proposing pedagogical strategies not only to stimulate collaboration and the diffusion of knowledge but also so that the course as a whole has positive results. For this, as the fourth strategy (IS4), we suggest that the participants who exhibit Low TP should be monitored differently, including actions such as face-to-face meetings at the start of and throughout the course, production of specific educational materials on the use of computational tools, weekly chats and/or video conferences with tutors and in- person presence on campuses. In extreme cases (participants who demonstrate a TP below 1.0), we propose a fif-

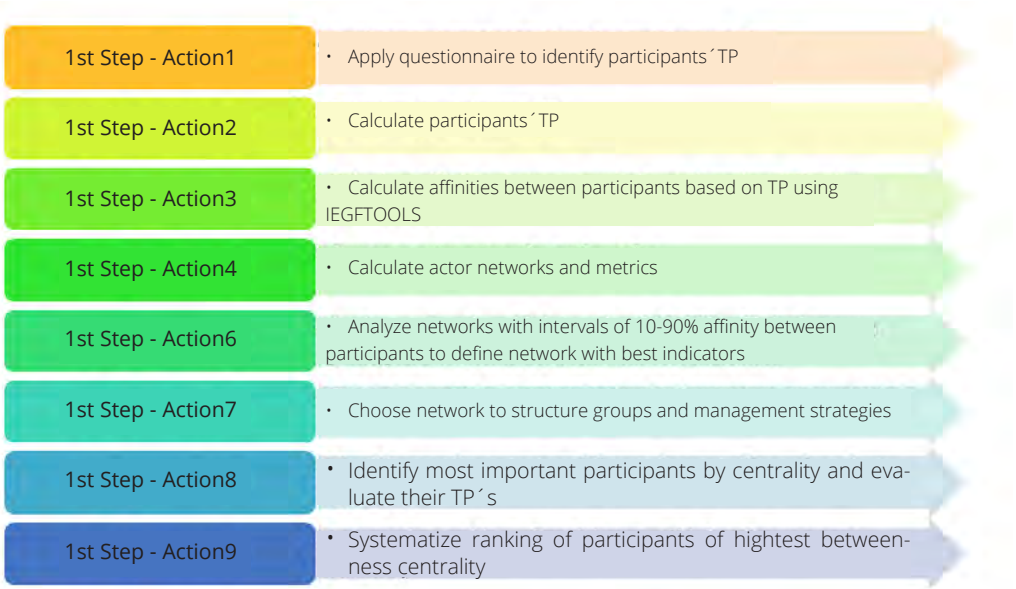

Figura 3. Diagnostic - First step of the planning and management process based on TP affinity networks for distance learning courses. Source: Carneiro (2014).

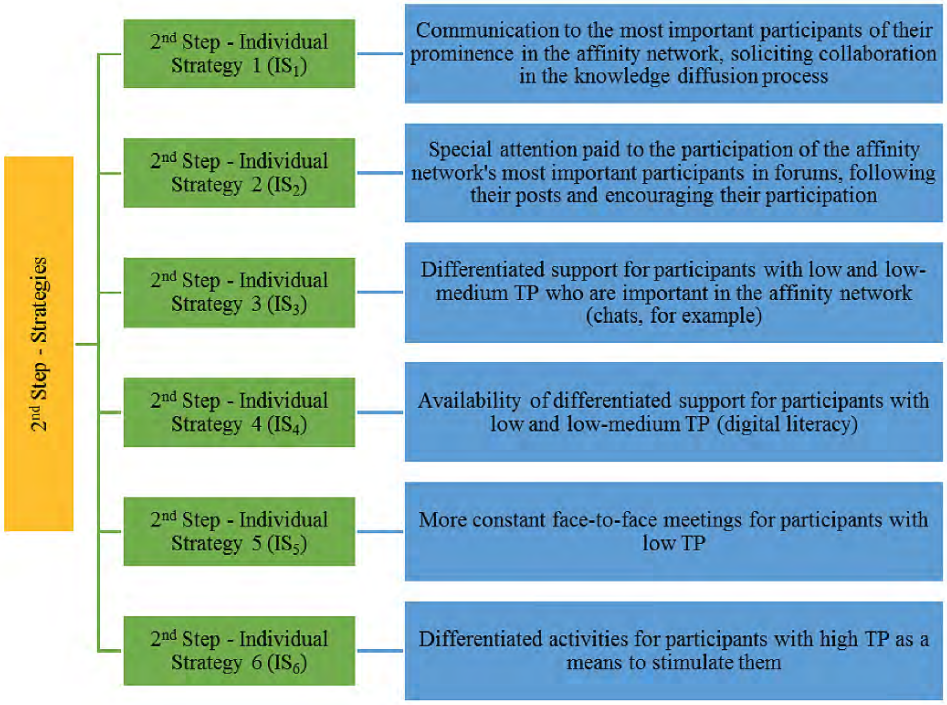

Figura 4. Definition of Strategies - Second step of the process of educational planning and management based on affinity networks of TP in distance-learning courses. Source: Carneiro (2014).

th strategy (IS5): that the course not be taught completely via DL but be a hybrid course, with face-to-face meetings throughout the process.

These meetings, to be organized based on the participants' profile, may, in addition to enabling targeted efforts directed to the specific needs of this group, avoid situations of inhibition among participants who are at different levels in the course.

We can also suggest that the course's first activities be conducted face-to-face with the help of the tutor[1] and posted in the environment during the meeting for this particular group.

The final strategy (IS6) consists of creating different activities for the participants with High TP, such as requesting that they act as leaders in group work or conduct differentiated research on specific course topics to stimulate them to participate more actively in the course. (Figure 4).

Once the second step strategies are implemented, the third step begins: grouping the participants by affinity. The model seeks to incorporate the complexity and acceptance of the differences as a point of departure for the pedagogical management of the course.

We suggest that the participants be organized into groups of at least 20 but no more than 30 participants. These groups will be formed in accordance with the participants' affinity. IEGFTOOLS also arranges participants into groups of 20-30. Because the grouping performed by IEGFTOOLS prioritizes affinity, groups with more and fewer participants can exist but within the limit of 20-30 participants per group.

The groups must be analyzed after they are formed. For this purpose, three procedures are proposed: 1. Analyze the TP of the participants who compose the group; 2. Calculate the betweenness centrality of the participants who compose the group; and 3. Identify the main participants in terms of betweenness centrality in the group (Figure 5).

For each of these analytical procedures, it is possible to define different strategies to monitor the group. Because these strategies are performed for the groups, they will be called grouping strategies (GS). The performance of these procedures need not be sequential, and the order proposed here can be changed because it does not impact the definitions of the strategies to be implemented.

After procedure 1 (analysis of the TP of the participants per group), the following strategies are proposed: If the majority of the participants have Low or Low-Medium TP, we suggest the establishment of a strong link between teachers and operational-support tutors (GS1) so that the monitoring of participants by teachers responsible for the development of the course content be performed in partnership with tutors responsible for operational support. If the majority of participants have medium or High TP, special attention should be given to the participants in this group who have low or Low-Medium TP so that they do not remain on the margins of the discussion and knowledge production process (GS2). If, in the group in question, the numbers of participants with High and Low TP are similar (e.g., 10 participants with High TP and 10 with Low TP), it is important to ensure that the issue of affinity between the participants is not overwhelmed by TP difference (GS3). (Figura 5).

For procedure 2 (analyzing the centrality of the participants per group), we propose the fo-

1 Tutors are those responsible for the operational support of VLE use. Teachers are those responsible for monitoring the study process of the course's programmatic content.

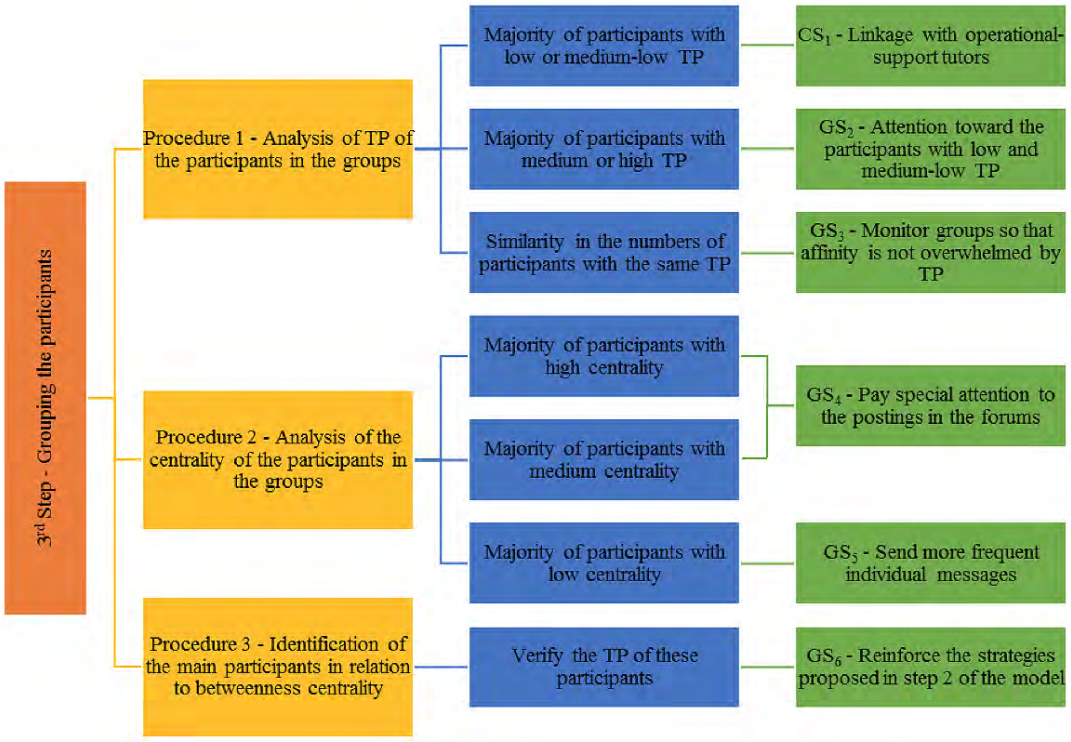

Figura 5. Definition of the grouping strategies (GS) - Third step of the pedagogical planning and management process based on networks of affinity of TP in distance learning courses. Source: Carneiro (2014).

llowing two strategies: GS4 - special attention to the posts in the group forums because there is high centrality due to the potential amplification of posts' impact given the greater ease of information diffusion; and GS5 - sending individual messages more frequently when the centrality of the participants is low.

For procedure 3 (identifying the main participants in the groups in relation to betweenness centrality), we propose that the strategies in step 2 be reinforced because the TP of these main participants will be identified, and this represents GS6.

The pedagogical management model based on affinity networks is synthesized with the aid of the activities diagram (Figure 6). The model's steps (i.e., assessment of the participants' TP, application of the pedagogical strategies according to the participants' TP and application of pedagogical strategies according to the affinity of the participants) are presented according to the logic of the model's application. To consolidate the methodological procedures of the proposed management model, in the next section, we present the application of the model to the Pradime/EaD.

5. DISCUSSION OF RESULTS

The affinity networks model is used to perform simulations. We conducted some simulations to develop the best affinity networks based on two courses of the Pradime/DE. We used the second edition of the Pradime/DE course, and we found that depending on student technological profiles, the model result was adequate. This means that the group was composed of individuals who influence and are influenced by

one another so that information and knowledge flows are potentiated. The proposed model found relationship patterns between the students based on their technologic profile.

Because the Pradime/EaD was the point of departure for the elaboration of the model proposed here, it is important to present a simulation of the model one of the editions of this program. Therefore, this section will present the management strategies recommended for the second edition of the Pradime/EaD to stimulate the dissemination of knowledge via affinity networks and contribute to greater success in the course. Nevertheless, when appropriate, we present elements of the two editions to better contextualize the application of the model. For example, Figure 7 presents the affinity networks between the participants in the two editions of the Pradime/EaD studied (i.e., 2010 and 2012), considering the criteria of 60% affinity between the participants.

The 2012 edition was selected to exemplify the application of the model because this edition had two advantages over the 2010 edition: the population was more diverse (MEDs and technicians) and all the different TP levels were identified. (Figura 6).

In the first step, the participants with greater between- ness centrality were ranked and arranged into three classification groups. The data were normally distributed, and the mean found was 0.012123765 and the standard deviation 0.012903481. Thus, the intervals for classification were [0.00; 0.012123765) [0.012123765; 0.025027246) [0.025027246) - low, medium and high, respectively.

After this ranking, the second step of the model begins (Table 3): implementation of the strategies. For this step, the participants were selected whose characteristics met the parameters of the decision structures modeled (diamonds in Figure 6). Thus, the following participants were chosen: P2- 16, P2-49, P2-01, P2-39, P2-11, P2-08, P2-30, P2-18, P2-25, P2-32, P2-31 and P2-66.

Participants such as P2-16, despite having low importance in the ranking (43rd), should receive differentiated strategies due to having Low TP (1.4), and strategies IS4 and IS5 should be applied for this purpose.

Participants such as P2-49 exhibit Low TP (1.4) but medium participation in the centrality ranking (25th). In addition to the strategies directed solely to the TP issue, such as IS3 and IS5, these participants should also be targeted by strategies exploiting their potential in the affinity network, such as IS2.

Participants P2-01 and P2-08 will receive the greatest number of strategies proposed in this model because they have an important role in the affinity network in relation to the questionnaire responses (6th and 4th position, respectively). Therefore, they can contribute strongly to the process of knowledge diffusion. However, by exhibiting strong operational limitations in relation to their mastery of technological resources, with Low and Low-Medium TP (1.4 and 1.8, respectively), they should be intensely monitored. Therefore, the strategies related to TP, which are IS3, IS4 and IS5, should be implemented, as should the strategies related to the network, which are IS1 and IS2.

For P2-39, because this participant is not relevant in the ranking (26th) and has Low-Medium TP (1.6), we suggest that only strategy IS4 be implemented.

Because P2-11 holds a mid-level position in the ranking (14th) and has Low-Medium TP (1.7), we recommend the implementation of strategies IS2, IS3, IS4 and IS5.

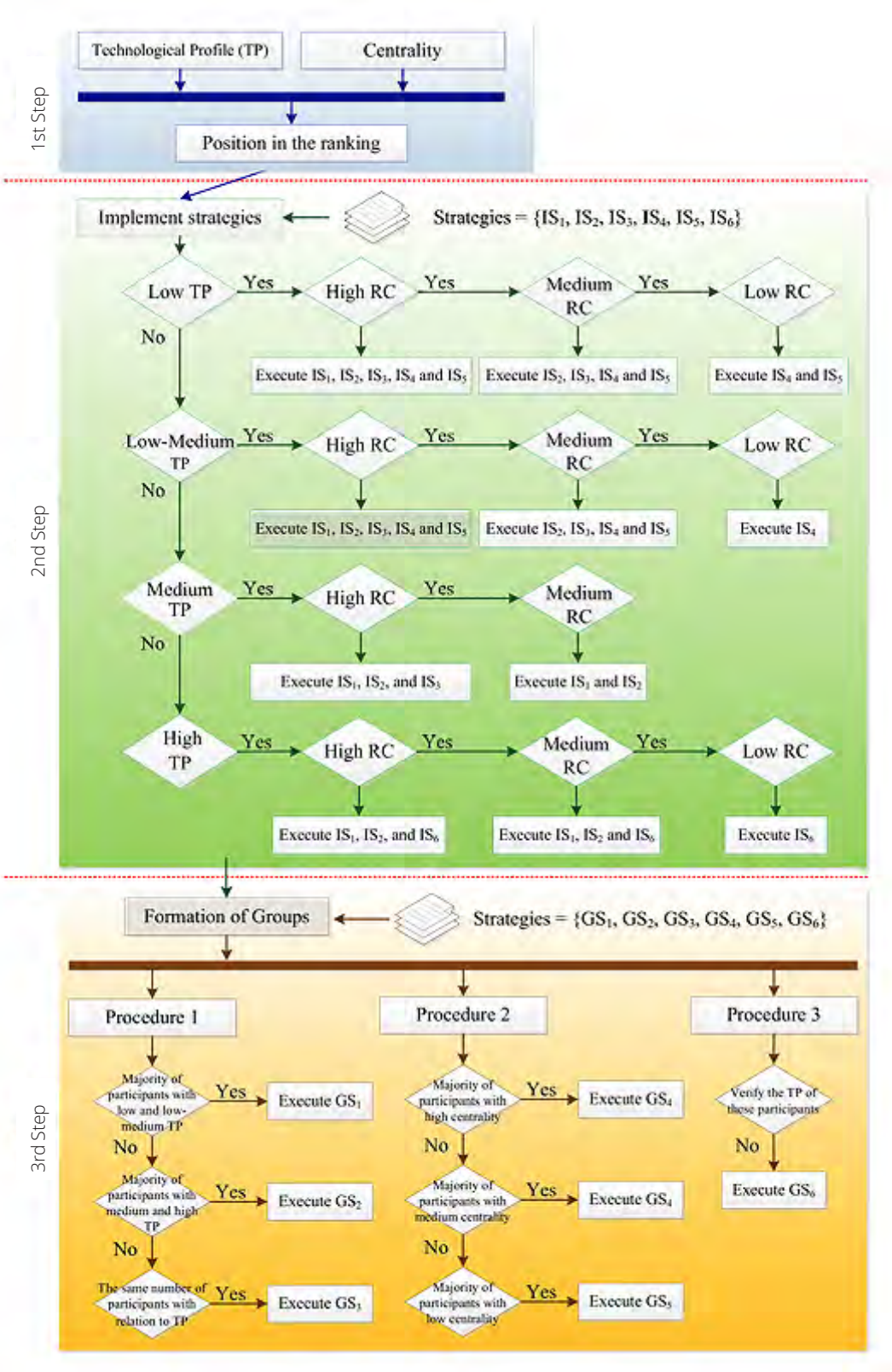

Figura 6. Activities diagram - educational management model based on affinity networks. Source: Carneiro (2014). Note: TP - technological profile; RC - ranking of betweenness centrality; IS - Individual Strategy; GS - Grouping Strategy. Source: prepared by the authors.

Participant P2-18, due to having a mid-level position in the ranking (17th), should be the focus of strategy IS1. Because his or her TP is medium (2.3), we do not suggest that strategies related to TP be implemented, nor do we suggest performing other activities than those already included in the course. For participant P2-25, who exhibits Medium TP (2.2) and first position in the centrality ranking, we suggest IS1, IS2 and IS3. (Figure 7).

Participants P2-31 and P2-66 are examples of participants with High TP (2.6 and 2.7, respectively) and can be the driving force behind the diffusion process because they have medium and high positions in the centrality ranking (13th and 3rd, respectively). For these participants, we suggest that strategies IS1, IS2 and IS6 be implemented.

We emphasize that strategies for participants with Medium TP, whose importance in the betweenness centrality ranking is low, were not proposed. These participants, on one hand, do not have problems mastering computational resources and thus are not targeted by strategies focused on TP; on the other hand, because they have no importance in terms of centrality, these participants are not targets of strategies centered on ranking. Therefore, they are monitored within the classical patterns of pedagogical assistance in DL courses, which include responding quickly to posts in the environment, correcting activities and sending stimulus messages, among other strategies mastered by professionals in the field.

We conclude, then, with the third step, which is the formation of study groups or groups that will be monitored by teachers and tutors depending on their affinity. In the case of the Pradime/EaD, the minimum affinity recommended such that two participants are in the same group is 60% because it was the highest percentage of affinity that generated a network where each participant is at least connected to another one. Therefore, three groups were formed; group 1 and group 2 were composed of 22 participants each, and group 3 had 24 participants (Table 4).

Figure 8 presents the numbers of participants by TP level in each group, which enables different strategies to be reinforced for each participant, especially considering his or her insertion in a group. Moreover, the fact is evident that two participants having the same TP does not mean that they have the same affinity. This aspect broadens the proposed management model and allows the richness of the relationship of cooperation, affinity and knowledge diffusion to be explored more thoroughly. (Table 3 - Table 4).

Group 1 has a few participants with High TP, who could consequently find themselves unstimulated. Therefore, it is important to apply strategy GS1. However, with the strategies proposed, these five participants can be asked to perform other activities that can stimulate them. This strategy aims to minimize the impact of these participants being in a group with other participants who have little mastery over operational resources.

In group 2, the strategies aimed at TP are little applied because 10 participants have High TP and seven have Medium TP. However, if the model did not allow for differentiated treatment for participants with Low TP, five participants in this group would have greater difficulty with the integration process because they are in a group where the majority master the use of technological resources, which could lead to embarrassment. Thus, applying GS2 is advised. However, having the operational support proposed by the model and participating in a group defined by affinities, these Low-TP parti-

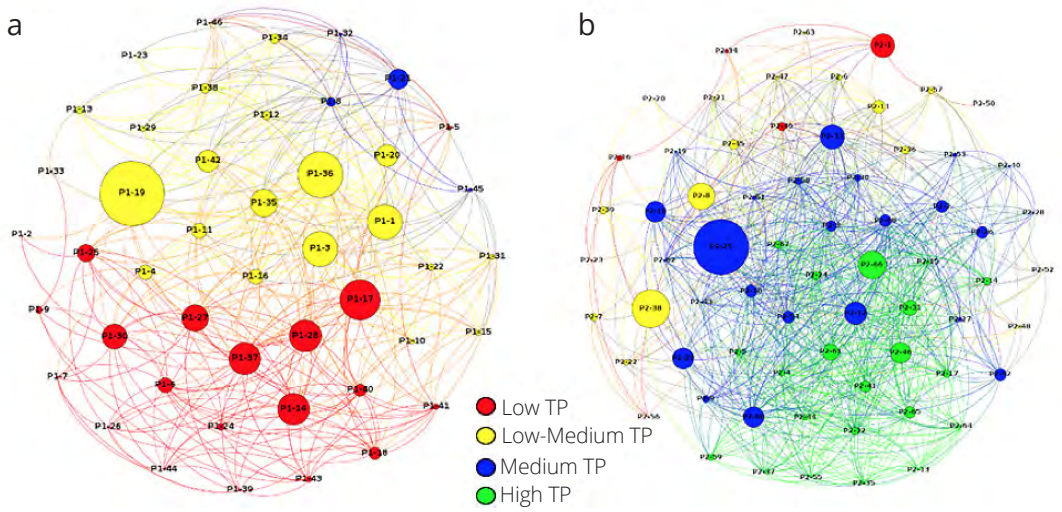

Figura 7. Networks of affinity between the participants in the Pradime/EaD, (a) 2010 and (b) 2012 editions, for 60% affinity between the participants. The betweenness centrality is indicated by the diameter of the vertex. Source: Carneiro (2014).

Table 3. Individual strategies by characteristics of the participants of Pradime/EaD 2012.

Participant	TP Level (value)	Ranking in relation to betweenness centrality (position)	Strategy
P2-16	Low (1.4)	Low (43rd)	IS4,IS5
P2-49	Low (1.4)	Medium (25th)	IS2, IS3, IS4, IS5
P2-01	Low (1.4)	High (6th)	IS1, IS2, IS3, IS4, IS5
P2-39	Low-Medium (1.6)	Low (26th)	IS4
P2-11	Low-Medium (1.7)	Medium (14th)	IS2, IS3, IS4, IS5
P2-08	Low-Medium (1.8)	High (4th)	IS1, IS2, IS3, IS3, IS4, IS5
P2-30	Medium (2.1)	Low (36th)	Specific strategy is not necessary
P2-18	Medium (2.3)	Medium (17th)	IS1, IS2
P2-25	Medium (2.2)	High (1st)	IS1, IS2, IS3
P2-32	High (2.8)	Low (27th)	IS6
P2-31	High (2.6)	Medium (13th)	IS1, IS2, IS6
P2-66	High (2.7)	High (3rd)	IS1, IS2, IS6

Source: prepared by the authors.

Table 4. Study groups to be monitored by teachers and tutors according to the affinity in the TP network and group strategies to be implemented for them.

Groups	Participants	Number of participants	Group strategies to be implemented
1	P2-1, P2-8, P2-10, P2-11, P2-21, P2-25, P2-33, P2-34, P2-47, P2-50, P2-2, P2-12, P2-14, P2-17, P2-26, P2-28, P2-29, P2-31, P2-32, P2-35, P2-38, P2-40	22	GS1, GS4
2	P2-41, P2-42, P2-46, P2-48, P2-49, P2-51, P2-52, P2-57, P2-60, P2-61, P2-65, P2-66, P2-3, P2-4, P2-5, P2-15, P2-18, P2-19, P2-24, P2-30, P2-37, P2-43	22	GS2, G65
3	P2-44, P2-45, P2-53, P2-55, P2-58, P2-64, P2-67, P2-68, P2-13, P2-6, P2-27, P2-36, P2-62, P2-7, P2-20, P2-22, P2-39, P2-56, P2-9, P2-59, P2-16, P2-23, P2-63	24	GS3, GS5

Source: Carneiro (2014).

cipants have improved chances of success because once the operational issue is overcome, they feel more stimulated to participate in the group.

Those responsible for monitoring group 3 will face a challenge because this group is divided into two sub- groups with the same number of participants but different perspective relative to TP: 12 participants with Low and Low-Medium TP and 12 participants with Medium and High TP. This group was the most complex in terms of monitoring because the issue of affinity may be overwhelmed by the strong differences in TP. Because the availability of different strategies will be critical during the monitoring of this group, GS3 is important.

When the formation of groups and the centrality ranking (Figure 9) are considered, group 1 will have greater ease in terms of knowledge diffusion because it has the greatest number of participants with high centrality ranking. Because the TP of this group is also favorable because 14 participants have Medium and High TP (Figure 8), this group tends to be easy to monitor; therefore, we advise only GS4. (Figure 8 - Figure 9).

Group 2 in terms of centrality must be well monitored because its number of participants with high centrality is small (only 3) and many participants have low centrality (13). However, the TP issue in this group will not pose a challenge, and therefore this group will not be difficult to monitor. Attention to the process of knowledge diffusion will be necessary; thus, we advise strategy GS5.

Group 3 will be the greatest challenge for its monitors because it lacks a participant with high betweenness centrality, and the majority possesses low centrality (93%). This group will require special attention from the manager because the professionals (teachers and tutors) monitoring it should be very experienced and educated regarding the challenges they will face in this process. We advise strategies GS5 and GS6.

Once the groups are formed and the profile of each group regarding the TP and centrality is evaluated, the next step is to identify the most

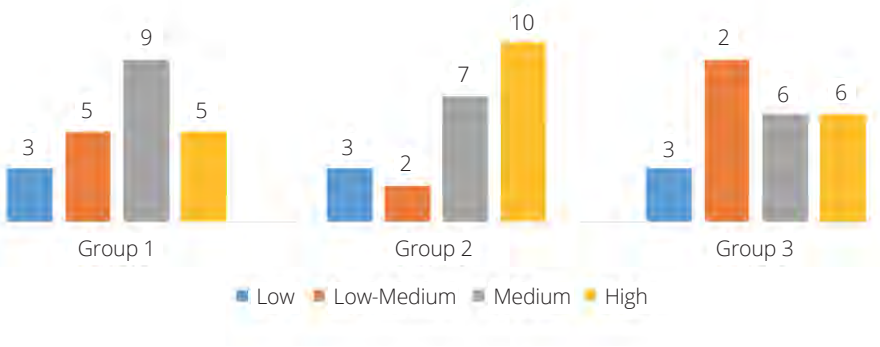

Figure 8. Number of participants by TP level in the groups defined by affinity - Pradime/EaD 2012. Source: Carneiro (2014).

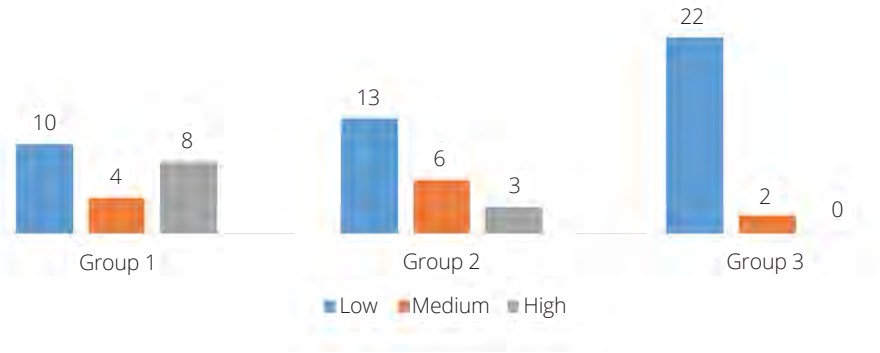

Figure 9. Number of participants by centrality rank in the groups defined by affinity - Pradime/EaD2012. Source: Carneiro (2014).

important participants in terms of centrality in each group and to identify which strategies should be implemented as a function of TP based on the strategies defined in the second step.

In group 1, the most important participant is P2-25, who has medium TP. Thus, only strategies IS1, IS2 and IS3 will be necessary. In group 2, participant P2-66 is the most important and has High TP. Thus, strategies IS1, IS2 and IS6 will be necessary. Because group 3 has no participant with high centrality, the participant with the highest value among those with medium centrality should be considered the most important; in this case, P2-68 and P2-54 share the same highest centrality value and TP level and should receive strategies IS1 and IS2.

It is important that throughout the entire process of implementing the strategies proposed here, the results obtained are constantly evaluated to generate a return on and success from the strategies implemented, according to the management by planning mold.

6. CONCLUSIONS

The DL pedagogical management model based on affinity networks sought to incorporate the perspective of complexity because while it is structured with activities that address di-

fferences among individuals, it also proposes activities that consider similarities among these individuals. The differ- ences were the basis for attempts to remedy individual short- comings that could jeopardize the pedagogical development of the course (Low TP), and the similarities were the basis to contribute to the dynamization of the learning process. The differences and similarities provided strategies to be applied with a focus on participants both individually and as a group.

The proposed model can contribute to the management of DL courses because the individual characteristics (i.e., technological profile) of each participant are used and therefore allows defining affinities that can be explored during the course. Therefore, this study contributes to increasing the number of investigations related to computer use and DL management.

The netnographic method combined with the case-study method enabled us to use a rich hybrid methodological process. This process accepted the specifics of the study on the Internet and enabled us, based on a specific case, to propose a model that is applicable to other DL courses, with minor adjustments in the questionnaire that give rise to the attributes of the network's actors.

This model is reliable because it considers actual data obtained from the application of direct questions to course participants, and we used a robust procedure to generate the affinity networks. In this study, the percent affinity was set at 60% because this value still produced a network with vertices connected to at least one other vertex. We suggest that the network with the greatest affinity always be chosen, as long as the minimum degree of the network is greater than zero and there are no disconnected course participants.

The model also seeks to contribute to the success of DL courses by reducing the dropout rate by establishing special strategies for participants with Low TP. Additionally, as discussed, studies show that participants with Low TP tend to have a greater probability of dropping out or failing this type of course.

We understand that the need for the participants to be truthful in their answers is a weakness of this study. Rather, the reliability of the model depends on interviewee responses for the second and third stages of the proposed intervention process to be performed in the most optimal way for the DE course. Therefore, it is important that DE course participants be alerted to the importance of providing accurate answers when filling the TP questionnaire. Participants must be informed that this is not only procedural according to the consent agreement but rather responses will lead to different ways of acting during the course from the perspective of pedagogical management and based on the roles of the students and tutors.

7. ACKNOWLEDGMENTS

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