

Study on distributed cognition processes and participation in collaborative construction activities in digital media

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Abstract—This research presents a work in progress in which we propose a mapping of digital experiences through the analysis of the behavior of a group of users from the social site Facebook with regard to the self perception of the interactive processes provided by some tools made available in this digital environment. We believe that the user of social networks, even when only recognizing the movements of their production process, access and information sharing reveals initial connection structures that act as mediating agents in the construction of social representations. Thus, the focus of interest is to observe the characteristics and properties conferred to the technological artifacts highlighting the correlation between the processes of distributed cognition and the participation in activities of collaborative construction in digital medium. This research assumed an exploratory nature, being the method employed essentially quantitative from the use of a structured questionnaire to perform the data collection organized by three sessions: a) characterization of the respondents; b) indication of the number of social networks that it is part of; c) evaluation scale composed of 15 variables on various aspects of interaction in the social network Facebook. The instrument was answered from a Likert scale of '5' (five) points, with values between '0' (zero) and '4' (four), zero being 'totally disagree' and '4' (four) "I totally agree". The questionnaire was applied on a university campus during the month of October 2017, with 10.79% of students enrolled in the institution responding to the instrument. The data obtained from the analyzes of the assertions of the questionnaire were examined by the SPSS software, through which the Principal Component Analysis (PCA) was used a multivariate statistical technique that consists in reducing a number of original variables in components not related to priori, aiming at reducing data to facilitate its interpretation.

Index Terms—distributed cognition, technological artifacts, interactive processes, auto perception

the Republic¹ [1] reveal that the interactions carried out on Facebook represent 83% of all information circulating in Brazilian social networks. According to the World Map of Social Networks and Other Cloud Services² [2], Facebook has a total of 1.49 billion users, of which 103 million are in Brazil. The Digital in 2016 survey³ [3] (We Are Social's, 2016) indicates that 58% of Brazilians make daily use of social networks, 49% are monthly users and 42% of individuals are connected to mobile social networks.

The set of these numbers expose the existence of a habit of the users in interacting with the social through the production and sharing of information in the middle of the digital social networks. Nowadays, we can see numerous researches in the field of social network analysis, bringing together different areas of knowledge, notably Sociology, Psychology, Anthropology and Mathematics, which seek to understand the constitution of this new "social fabric" [4].

In Brazil, studies associated with Social Network Analysis (ARS) and the Actor-Network Theory (ART) have problematized this social interaction. Distinct in their central concepts and methodological approaches, the ARS describes the structure of social networks from the tradition of social sciences ([5]–[7]) using computational models of visualization, calculation and measures for data collection and analysis. However, the studies associated with Latour's TAR [8], [9] are linked to so-called sociology of translation, dedicated to the study of relations between actors [10], [11] especially with regard to associations and movements of connection and disconnection [11]) from materialistic and semiotic approaches.

I. INTRODUCTION

Data from the media research carried out by the Special Secretariat for Social Communication of the Presidency of

¹<http://www.secom.gov.br>

²<https://iredes.org/>

³<https://wearesocial.com/uk/special-reports/digital-in-2016>

We believe that in order to transform shared information into effective processes of social interaction, a cognitive awareness is required of the processes of appropriation, both of the contents and the tools, as well as of the social groups that the users wish to be part of. As each individual knows and experiences situations subjectively, the same situation experienced by different people can result in different visions and learning. Thus, the focus of interest is to observe the characteristics and properties conferred to technological artifacts highlighting the correlation between the processes of distributed cognition and participation in collaborative construction activities.

The correlation between new cognitive processes and the intensification of participation in activities of collaborative construction of content in digital environments of social interaction has been the focus of numerous researches, to cite those made by ([12]–[16]), to mention just a few.

According to [12], the network of computers scattered around the globe gave people the possibility to exercise their connected intelligence in groups of different dimensions and contexts, leading to a multiplication of reference sources. In the same perspective, the foundations of Distributed Cognition were consolidated by [13], that when analyzing the cognitive processes used in the operation of ships and aircraft [17], concluded that a job depends on the crew's skills as well as the efficient use of technical artifacts. The authors seek to affirm that in order to know and act in the world, the mind makes use of body, environment, technical objects and social interactions, and this "use" is a process of cognition "amplified" by referring to the use of a broad repertoire of abilities (sensory-motor, perceptive, emotional and social).

Thus, the purpose of this article is to present a mapping of digital experiences through the analysis of the behavior of a group of users of the social site Facebook, regarding their self-perception of the cognitive processes provided by some interactive tools made available in this digital environment. In order to do so, we identify in the opinion of young users the extent of their participation in this social context, the most used interactive tools of Facebook and what cognitive aspects are associated with the existential meaning granted by them to this digital social network site.

The choice of young people is justified by the fact that adolescents between the ages of 16 and 18 years were born in the midst of the information society, being habitual the incorporation in their daily social relations via digital networks. In addition, it is important to verify the cognitive potentialities of the spontaneous and informal contexts of the Internet as tools for informal e-learning [18], since content produced and shared through social networking sites can provide education with personalized experiences, collaboration, information sharing and active participation.

The remaining of this paper is organized as follows. In Sec.2 the methodology behind the mapping of digital experiences through the analysis of the behavior of a group of users of the social site Facebook with regard to self-perception of the interactive processes provided by some tools made available in this digital environment is detailed. In Sec. 3 the results of the

qualit-quantitative evaluation are given and discussed. Finally, in Sec. 4 the conclusion and perspectives of future work are presented.

II. METHODOLOGY

This research assumed an exploratory character, being the method used essentially quantitative from the use of a structured questionnaire for the accomplishment of the data collection, organized by three sessions: a) characterization of the respondents; b) indication of the number of social networks that it is part of; c) scale of evaluation composed of 15 variables on various aspects of interaction in the social network Facebook, having been discarded five of these aspects during the analysis phase. The instrument was answered from a Likert scale of '5' (five) points, with values between '0' (zero) and '4' (four), zero being 'totally disagree' and '4' (four) "totally agree".

The questionnaire was applied in a university campus during the month of October 2017, with 10.79% of the enrolled students (N=732) on the campus responding to the instrument (n=79), but not a probabilistic sample. The data obtained from the analysis of the assertions of the questionnaire were examined using the SPSS software [4], which used the "Principal Component Analysis" (PCA), a multivariate statistical technique that according to [19] is to reduce a number of original variables in components not related a priori, aiming at the reduction of data to facilitate their interpretation ([20], [21]).

In order to verify the internal consistency of the factors and indicate the reliability of the measurements, the Cronbach's Alpha coefficient [22] was calculated. For Silveira (1993), a minimum acceptable value for Cronbach's Alpha depends on the intention to analyze the scores resulting from the instrument. However, it is important to consider that the coefficient close to 1 (one) means that the instrument is able to detect the differences between the respondents in the investigated group.

III. RESULTS AND DISCUSSION

The results of this research show a circumstantial panorama of the interactive processes provided by the tools available in the social networks, since 10.79% (n=732) of young people who attend the courses offered by this educational institution responded to the instrument of data collection. The element that collaborates to approximate the results presented here of the real context in which they are situated is the balanced distribution of the young age group, as well as its massive insertion in the digital social networks.

A. Characterization of Research Subjects

All participants in this survey were Facebook users. Most of them are aged between 15 and 23 years (Table I), with an average of 17.4 years of age and the mode of 17 years. The "female" sex was 63.3% and "male" 36.7% of the respondents (n = 79).

The number of social networks used by respondents is shown in Table II. In this context, most individuals (73.5%)

TABLE I
CHARACTERIZATION OF THE SAMPLE

Age	Gender		Total
	F	M	
15	1	0	1
16	12	10	22
17	27	10	37
18	7	6	13
19	1	1	2
21	0	1	1
23	1	0	1
Total	49	28	77

are enrolled in 4 to 8 social networks groups, with the highest percentage of users (22.8%) attending six social networks. The following social networks were mentioned: Facebook, Twitter, Massenger, Whatsapp, Goglee +, Snapchat, Instagram, Skype, Discord, Tinder, YouTube, Badoo, Skood, Pinterest, LinkedIn, Viber, Wattpad, Happen. According to [23], these digital environments alone do not present a social network, but rather it is constituted by a set of social networks established from the appropriation that users make of their tools. This feature originates the concept of Social Network Site [24] because it represents an environment in which different modes of interaction are established among social actors from the constitution of a user profile, a network of connections and a dynamic of interactions. Thus, in social networks on the Internet it is possible to have hundreds of active social connections through which information is constantly being received [23].

It has been observed that the post profile and the relations established between the users of groups occur through three resources: (i) closed groups, whose creation pattern allows only members to accompany the activities, but with the name of the group and the visible participants; (ii) public groups, in which all content is accessible to users of the social network; and (iii) secret groups, which maintains secrecy about the data and activities of its participants.

In addition to these interaction tools, were identified other characteristics of social networking sites that help in the structural understanding of social practices on the Internet. Some of these characteristics were associated by [24] with the concept of affordances, since (i) the persistence of interactions over time; (ii) the replicability of information; (iii) the scalability of the interaction amplitude; and (iv) the searchability of published information that allows the analysis of elements emerging from the appropriations of technical artifacts.

[23] also observes characteristics related to the dynamics of the interactions: the invisibility of the audience among the actors due to the difficulty in discerning the flow of information; the collapse of contexts when information is shifted from its original contexts and replicated in others; and the blurring of the boundaries between the public and

the private, reflected in the difficulty in demarcating spaces of a particular nature, since, in principle, all information in these environments is public. However, we believe that, from this linkage, there are at least two social phenomena: (1) the sense of existential need and (2) granting "voice" to those who would not have it outside digital social networking sites.

B. Evaluation scale of the behavior of the user

The answers to the 15 questions were organized and analyzed in SPSS software. After some steps and decisions, five variables were discarded: "Most of my friends are on Facebook"; "Sharing a post means the message in the post was so representative that I want more people to see it"; "I've shared Facebook posts before reading the content of the link"; "Comment a post, it means that I need to state my opinion about the content expressed in the message"; "Sometimes I use Facebook to store new information until the appropriate insertion time". It was noticed that some users understood these affirmations as a positive influence and others as negative influence and this construction error, not perceived in the adaptation of the instrument, caused the need to exclude such variables from the analysis.

The study by [25] shows that it is valid to reduce the number of variables and to limit the number of components. Table III shows the Cronbach's Alpha rates for the three analysis situations at work, showing the consistency of the data. According to [26] the closer to 1.0 and above the 0.7, the better the reliability of the data.

In the PCA, all 10 variables were considered, as they had commonality rates above 0.400, with the highest value being 0.756 and the lowest being 0.460. This factorial load demonstrates the strength of correlation between the variables with the strongest variable of the analysis, as [21] indicate. Subsequently, these were grouped into three components, representing 58.70% of the variance explained, with component 01 being the most significant of these categories, accounting for 31.35% of the variance. The component was composed of five variables, presenting an internal KMO of 0.745 and being named "aspects related to the participation processes".

Aspects related to participatory processes (Table IV) demonstrate that most users "produce", "share", "have the autonomous ability to learn", "enjoy" and "influence opinions" of other individuals through the use of site interaction tools. The grouping of these actions reveals signs that the content produced in media to digital social network groups is at the service of social interaction, placing information in the space between the actors and the current and virtual systems of socialization [27].

This understanding supposes that the meanings attributed to situations are elaborated and shared within these interactions themselves, thus configuring the social bonds [23] produced in and by the Facebook groups, since most of the young people (73.5%) are included in 4 to 8 social networks groups, as already shown in table 02.

Another set of characteristics revealed by these aspects is related to the cognitive processes of collaborative construction,

TABLE II
SOCIAL NETWORKS USED

<i>N social networks per user</i>	<i>Frequency</i>	<i>Percent</i>	<i>Valid Percent</i>	<i>Cumulative Percent</i>
2	4	5.1	5.1	5.1
3	4	5.1	5.1	10.1
4	9	11.4	11.4	21.5
5	12	15.2	15.2	36.7
6	18	22.8	22.8	59.5
7	6	7.6	7.6	67.1
8	13	16.5	16.5	83.5
9	2	2.5	2.5	86.1
10	4	5.1	5.1	91.1
11	3	3.8	3.8	94.9
12	1	1.3	1.3	96.2
18	3	3.8	3.8	100
Total	79	100	100	

Fonte: pesquisa/ Autor

TABLE III
CRONBACH'S ALPHA RATES PRESENTED IN THE ANALYSIS.

15 variables	12 variables	10 variables
0.687	0.691	0.730

Fonte: pesquisa/ Autor

since the mode of use of technological artifacts demonstrates both the cognitive capacity of distribution and the formation of the cognitive niche. The user, when producing certain content, share and receive feedbacks, establishes a network of relationships that, when gaining credibility (visualization number), becomes a cognitive niche in which they are constructed and used in function of their potential transference or generalization.

The component 02 explains 14.76% of the variance being composed of three variables, with internal KMO of 0.559 being named "aspects related to the social networking site". Thus, to transform shared information into effective processes of social interaction, it requires a cognitive awareness of the processes of appropriation, both of the contents and of the tools, as well as of the social groups that the users wish to be part of. Simply, having a profile on a social networking site and sharing information indiscriminately does not grant the user the condition of participating in the collaborative social construction, for that a citizen education is necessary.

The aspects related to the social networking site (Table V) show that young people "access facebook daily", "linking to posted content" and "do not conceive of social life outside digital networks". From this correspondence, we find that young people are now searching the digital networks for their self-identification processes, which were previously established in the school, church, community, etc.

Its conformation implies the interaction of individual and

collective identities, which imprint various particular characteristics (eg values, customs, beliefs, traditions, etc.) with this principle of national, regional, local or ethnic identification.

Thus, since the emergence of the virtual electronic space represented by networks, such as the Internet, traditional identities have been shaken because this new environment communicational-information allowed for an interactive dialogue and the displacement/decentering of traditional "fixed" identities, reformulating them and modifying them through the flows of electronic networks. Component 03 explains 12.58% of the variance being composed of two variables, with internal KMO of 0.500, being named "aspects related to forms of social interaction".

The aspects related to the form of social interaction (Table VI) show that young people "are influenced by social networks" because they "like the comments" attached to their publications. The importance of the opinion / information that comes from the other for decision making is revealed by that grouping. Although the decision-making process represents an essentially individual activity, it will be through the treatment of the information received that the individual will determine their choices. [27] points out that information is cognitively structured in associative networks and in memory schemes. For the author, the models of reality, that is, our worldview, represent our repertoire contained in memory. Thus, by manipulating the information we are structuring our cognitive system.

The correlation between new cognitive processes and the intensification of participation in activities of collaborative content construction in digital environments of social interaction has been the focus of countless researches, to mention those made by ([12]–[15], [28]), to mention just a few. However, this notion of interconnected cognition had previously been addressed in the studies of [29] and [30], for whom cognitive

TABLE IV
COMPONENT 1 - ASPECTS RELATED TO "PARTICIPATION PROCESSES"

	Variables	Charge	Average	median	voga	Standard deviation
V08	I often produce content for Facebook like comments, photos and videos.	.768	1.44	1	1	1.19
V05	I believe that this production can foster autonomous learning processes.	.736	1.64	1	1	1.26
V09	I believe that this production can foster autonomous learning processes.	.732	2.35	2	2	1.10
V15	When a "friend" likes my posts in the group, I feel like I'm producing content in the midst of social relationships.	0,615	2,58	3	2	1,15
V06	I believe that the discussions provided in the Facebook groups in which I participate can influence opinions.	0.559	2.62	3	4	1.34

Fonte: pesquisa/ Autor

TABLE V
ASPECTS RELATED TO THE "SOCIAL NETWORKING SITE"

	Variables	Charge	Average	median	voga	Standard deviation
V01	I use Facebook every day.	.754	3.20	4	4	1.14
V10	I like this post, it means that I read and understood the message of the post, agreeing with it.	.667	2.85	3	4	1.29
V02	I can live without accessing Facebook.	-.575	2.48	2	2	1.24

Fonte: pesquisa/ Autor

TABLE VI
COMPONENT 3 - ASPECTS RELATED TO FORMS OF SOCIAL INTERACTION

	Variables	Charge	Average	median	voga	Standard deviation
V04	By accessing Facebook only "short" the comments	.861	1.68	2	0	1.30
V07	Facebook has already influenced my life choices.	.475	1.31	1	0	1.22

Fonte: pesquisa/ Autor

processes are widespread among members of a given group. However, such theses were developed based on a model of "mental society", whose focus of cognition resided in social processes external to individuals [13]. The studies conducted by Hutchins [13] assume that human cognition is not restricted to the limits of the brain and body, but is distributed in a system formed by the individual in interaction with social, cultural and technological artefacts in a given environment. These artifacts, considered by the author as tools carrying cognitive processes, consist of devices used by humans to perform a given activity, being able to improve the cognition and performance of the person who uses it ([13], [31]). In this perspective, Distributed Cognition seems to be adequate for the understanding of how Collective Intelligence [32] manifests at the systemic level, through the representation of knowledge and its propagation between individuals and artifacts [13].

For [13], the process of cognitive distribution occurs from three instances: in the first, cognition is shared among the members of a social group; in the second, this interaction between individuals establishes a system, called cognitive

niche, that according to the author, involves a set of representations of internal (memory, language) and external (material and/or environmental) structures; and in the third instance this cognitive process acquires historical-temporal characteristics, so that previous events can transform the nature of the present. [33] approaches language as a niche example, suggesting that by materializing thoughts into words we structure our environments, creating cognitive niches that increase and invest us with a variety of thought processes. In addition to words and daring a little more, [34] further states that humans are already cyborgs, in a radical sense of symbiotic human-tech beings. For the author, cognitive artifacts are tools built by men who act as prosthetics capable of transforming human capacities, creating new skills and drastically modifying problem solving processes.

IV. FINAL CONSIDERATIONS

From the mapping of the self-perception of the cognitive processes provided by some interactive tools provided by Facebook, it was possible to perceive that the grouping of

the actions of the users in this social network site reveals signs that the contents produced among the groups of digital social networks are service of social interaction, placing the information in the space between the actors and the current and virtual systems of socialization. This understanding assumes that the meanings attributed to situations are elaborated and shared within these interactions, shaping the social bonds produced in and by the Facebook groups, since the range of participation of the young people (73.5%) in this context reveals that the same participate in an average of 4 to 8 social networks groups.

Another finding refers to the cognitive potential presented in the behavior of users of social networking sites. Thus, when we affirm that technologies are developed to provide human beings with new capabilities; and if we assume that they modify the way we solve problems, make decisions or perform tasks, we can consider in a macro analysis that the internet represents an example of a cognitive niche and the computer is its technological artifact.

However, when we specialize in this exam to consider digital social media, we have come to affirm that groups, blogs and websites can also be described as cognitive niches, that is, spaces structured by artifacts (words, images, videos) that act in different ways on mental processes related to interaction interfering in social choices.

In this article, the verification of these mental processes is associated with the awareness of the behavior of the use of interaction tools, that is, how the acts of posting, liking or sharing a set of images, messages and / or videos represent cognitive pathways for users. This relationship between behavior and cognition, in these environments of connectivity, interaction and knowledge production, requires the adoption of a new learning model. We must broaden our view of pedagogy to enable young people to be active participants and co-producers of content in the socially chosen environments of their choice so that learning becomes a means of supporting their goals and their individual needs.

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