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THE IMPOSITION OF DIGITAL CULTURE IN BRAZILIAN EDUCATION DURING THE COVID-19 HEALTH CRISIS AND THE EXCLUSION OF SERTANEJOS, INDIGENOUS, AND QUILOMBOLAS

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ABSTRACT

The COVID-19 global health crisis has impacted the Brazilian education system, constituting a real concern for science education research. What are the relationships imposed by analog and digital subcultures on virtual educational relationships in a multicultural classroom in the Sertão region of Pernambuco, during the COVID-19 pandemic? In pursuit of this problem, we aimed to analyze the intercultural relationships between analog and digital subcultures that permeate indigenous, quilombola, sertanejo, and urban cultures in a virtual didactic-pedagogical intervention. We realized that the development of a digital culture depends on the students' cultural background, as well as access to quality technologies and the Internet. We found differences in the appropriation of the digital subculture according to out-of-school cultures. This affects and dynamizes the learning process in a digital educational model, reinforcing the role of the school and the teacher in promoting didactic-pedagogical strategies that contribute to intercultural learning. The digital subculture can intensify the exclusion of minority cultures if it assumes practices of colonizing domination, where it is overvalued compared to the analog subculture that constitutes the students.

Keywords: analog, intercultural education, multiculturalism, pandemic, subculture.

INTRODUCTION

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The recent period of health crisis has had a profound and intense impact on world education, and Brazil has not been exempt from this. The remote teaching model adopted on an emergency basis in our country constitutes a multifaceted problem: considering the multicultural context in the Sertao of Pernambuco[4], Brazil, has the use of remote teaching during the Covid-19 syndemic enabled inclusive and intercultural education for all? Considering that digital culture requires, above all, access to hardware and software technologies, using smartphones, notebooks, tablets, and Internet access. These technologies are resources that are rarely accessible to working-class, low-income and ethno-cultural minority populations in developing countries like Brazil.

In a multicultural context where ethnic groups have a strong influence of analog culture, such as indigenous and quilombola communities, where traditional knowledge and technologies are passed down through orality, painting, and handicrafts, a school that implements digital education for an analog audience can compromise learning. Even more so when a particular socio-cultural group does not have adequate access to information and communication technologies (ICT). This reality imposes on us a socio-cultural educational reflection that favors the hypothesis that remote learning, used as an emerging educational model, has excluded certain groups from the educational process.

In this work, we understand analog and digital cultures as subcultures, according to Aikenhead (2001), which means cultures that constitute a cultural group. The term subculture has no pejorative value, but of the constitutional organization of one culture that is constituted by another. Such an understanding is important for the consideration of indigenous, quilombola cultures normally homogenized by the dominant culture.

In this text we choose to refer to the health crisis as a syndemic and not a pandemic, because we consider the definition of Singer et al. (2017, p. 941) to be adequate, when they classify syndemic as a process of sanitary coverage “through a broad approach, considering the biosocial context, since the consideration of other pre-existing factors, such as poverty, and the existence of other diseases that can potentiate its effect.” We consider that syndemic by the broad effects, which go beyond the specific health crisis itself, reaching other areas, such as education.

Based on cultural diversity in a high school class integrated to the Agricultural Technician of the Federal Institute of the Sertao Pernambucano (IFSertãoPE) in the city of Salgueiro in

[4] semi-arid region in the interior of the state of Pernambuco, Brazil.

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Pernambuco, we seek to understand intercultural elements between the cultures involved and the analog and digital subcultures. Our objective was to analyze whether and how students from certain socio-cultural groups were excluded from the educational process. We sought to carry out this analytical study in complex perspective, referring to the scientific paradigm of complexity of Edgar Morin (2003), which contributes to the understanding of reality.

In this context of cultural diversity, it is pertinent to inform that quilombolas are descendants of Africans who, in Northeast Brazil, fled from the slavery system in colonial time and settled in communities called quilombos in the hinterlands (Carril, 2017, p. 548). The Quilombo of Conceição das Crioulas, Salgueiro-PE was founded in the 18th century.

Brazil has 305 indigenous ethnicities and 274 different languages, and the state of Pernambuco has 13 indigenous ethnicities, being the 4th state with the largest indigenous population and the one with the largest population of urban indigenous people in the country (Silva, 2020, p. 63-64). The Truka and Atikum who make up the school community in Salgueiro-PE speak Portuguese.

The “sertanejo” people were formed by the cultural conjunction between Europeans, Africans, and Indigenous people, characterizing the unique and syncretic culture that were shaped by the coexistence with the semi-arid region of the Brazilian Northeast and the caatinga biome, cattle raising (Santos de Aquino, 2022, p. 42-43).

REMOTE TEACHING

The remote teaching model adopted in Brazil as a strategy to face the global health crisis due to Covid-19 is characterized by the adaptation of the use of information/communication technological resources, such as videoconferencing applications intended for meetings in the business world. According to Vieira (2020) remote teaching maintained the pedagogical project of face-to-face teaching, not changing the methodology used. Hayashi, Almeida, and Arakaki (2021) classify it as a model of traditional one-way teaching, where teachers present and students watch. Pedagogically, remote teaching is based on the performance of synchronous activities to the point that school institutions teach classes through videoconferencing platforms at the same time as face-to-face classes. Another aspect was problematized by Rondini, Pedro and Duarte (2020) considering the teacher-student relationship, because in this context teachers are culturally challenged when they use technological tools to their often-analog pedagogical practice, associating, therefore, the

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context of cyberculture with their didactics, to teach the generation born in the digital age. Rabardel's (1995) tripolar model, human-object-machine relational scheme, has served as a support for understanding education in the times of Covid-19. The object to which the author refers to is what causes human-machine activity, whether from a practical or cognitive point of view, and may or may not transform its initial state to a final state. This transformation is understood as a process of conceptualization as advocated by constructivist theories. The tripolar model was theorized to enable the understanding of the use of digital instruments and the processes of instrumentation (use of digital instruments without critical reflection on the object, not enabling its transformation) and instrumentalization (when the operation of the human-object-machine tripolar system promotes the transformation of the object through practical and cognitive changes).

In this way, we were able to represent the tripolar model in remote teaching as the relationship “teacher/human-machine-object-machine-human/student”. The teaching process occurs in the teacher-machine-object relationship [...] being more valued than the learning process that occurs in the other relational half represented by the system “[...] object-machine-student”. This corroborates with the nomenclature of the remote teaching model.

To seek to equate the problem of the teaching and learning process promoted by remote teaching, we proposed a digital education methodology, from synchronous and asynchronous moments, but that aims at principles of active, intercultural, decolonial, interdisciplinary and complex learning for the teaching and learning of biochemistry. The proposal was entitled “On the Trail of Milk” in which it uses the transversality of the milk theme between the cultures of the students and the school culture represented by biochemistry in contextual, interdisciplinary, intercultural and complex situations.

CULTURAL RELATIONS

Studying cultures and their relationships is a challenging task due to the polysemy of the term “culture”. Acioly-Régnier (2010, p. 9) cited the study by Dasen (2002) that highlighted the work of anthropologists Kroeber and Kluckhohn who identified 164 different definitions for the term "culture" in 1952. This polysemy makes us consider the complexity of this term which leads us to the acceptance of definitions that complement each other, better conceptualizing the term. Thus, we consider together the conceptualizations of Phelan, Davidson, and Cao (1991) that define it as the norms, values, beliefs, expectations, and

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conventional actions of a group, and that of Leavitt (1995), who considers the material, social, cognitive and linguistic aspects as constituents of culture. The concept is further expanded by Stairs (1995) which includes ecological aspects.

Understanding culture as a condition of singularity that is established by the representation of identity and difference constituted by the system of signification, as silva (2014) argues, subjects from different cultures can relate to each other in different ways, and socioeconomic and cultural power modulates such relations.

UNESCO (2006, p.16) defines a minority culture that generally refers to marginalized or vulnerable groups that live under the shadow of majority populations and are attached to a different and dominant ideology. It is clear in this definition that the dominant culture wields a power over marginalized so-called minority cultures. This conceptualization serves us to understand the student population as a minority, because northeastern sertanejos and mainly indigenous and quilombolas, constitute marginalized cultures in Brazilian society that is characterized by dominant white, sexist, Christian, urban, heteronormative and military cultures (cultural combinations inherited from European colonization) and currently also inserts the digital one.

As a culturally diverse society, cultural relations can be multicultural, intercultural, and cross-cultural. These relational types, crossed by the power structure, determine the overlapping of one culture to the other until the closest coexistence of an egalitarian, equitable, and democratic condition.

It is salutary to differentiate the terms multiculturality and multiculturalism, the former represents an asymmetrical sociocultural relationship in a society that assumes cultural diversity, while multiculturalism comes from the American policy of orientation to the recognition of cultural diversity in society, such as a program that seeks to guarantee the expressions of different cultures in society based on a dominant and colonial culture (Meer & Modood, 2012; Weissman, 2018).

Interculturality goes beyond the limits of multiculturalism because the conditions of difference and identity of the different cultural symbolic systems coexist interactively and democratically. For Weissmann (2018, p. 24), in interculturality the combination of cultural elements is unexpected and complex, and the process is named mestizaje, which means talking about a combination of heterogeneous elements, in which each one preserves its particularity while the difference remaining.

Transculturality is a term used by the Austro-Hungarian-French current of thought housed in

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psychoanalysis (Weissman, 2018, p. 23). It is constituted by the combination between anthropology and psychoanalysis for the understanding of the construction processes of the psyche of the migrant individual.

CULTURAL FRONTIERS

In this work, we also address Aikenhead's (1996) conception of cultural frontiers, which establishes the limitations in the construction of scientific knowledge due to the different symbolic systems of each culture guided by the power relationship that imposes the marginalization of minority cultures such as autochthonous, indigenous or aboriginal cultures.

However, this imposes on us the need to clarify the concept of frontiers. The frontier Collins Dictionary (2023) presents the term “frontier” in American English as a noun that means “the part of a country that borders another country; boundary; border; the land or territory that forms the furthest extent of a country’s settled or inhabited regions; the limit of knowledge or the most advanced achievement in a particular field” and also presents the definition of border in abstract character “extreme point, more advanced or deeper, of something of abstract character”.

Such perspectives can be evidenced by Perez-Caraballo (2011a, 2011b) when studying the intercultural constitution of the Franco-Genevan and Uruguayan-Brazilian border people. It was found that the abstract character of geographically bordering regions could also be characterized as a hybrid space marked by mobility, transition, integration, and cultural, linguistic, and ethnic exchange. This conception was validated by Weissman (2018), pointing out that, due to globalization movements, the notion of culture coherent with a territory and a people falls apart.

The conception of borders has a peculiarity in the works of Aikenhead (1996 and 2001), who, in his educational studies with indigenous people in Canada, contributed to the proposition of the theory of crossing cultural frontiers in science teaching. This theory is based on social constructivist theories such as O’Loughling’s socio-cognitive model of teaching and learning, which makes social power and its privileges explicit in science classes. The theory consists of teaching Science from the context of the indigenous people, considering the language in its three dimensions: English, the technical-scientific language, and the indigenous language.

In the logic of Aikenhead (2001) scientific education from the cultural perspective is based

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on several hypotheses such as the consideration that Western science is a culture with its own identity formed by various subcultures of Euro-American societies; people live and coexist identified in various subcultures characterized by languages, ethnicity, gender, social class, occupation, religion, and geographic region; people move from one subculture to another, in a process called “cultural border crossing”; people's main identities may be at odds with the culture of Western science to varying degrees which can hinder the crossing of cultural boundaries affecting learning, exactly on this weighs the importance of the teacher in mediating this crossing and consequently enabling learning.

Thus, we defend a notion of frontiers that is considered in its complexity. Thus, it is possible to address the relations of cultural boundaries not only linked to the materiality of the borderline determination of a geographical territory, but also to the immateriality of the cultural symbolization systems that constitute identity and difference. But when two distinct cultures interact, they will always be confronted with each other by the immaterial border dynamics of the cognitive.

In addition, the concept of subculture is for us, of great importance because it allows us to perceive analog and digital cultures as such. For they constitute and cross other stronger cultural identities such as the ethnocultural ones represented by indigenous, quilombolas and sertanejos. During the Covid-19 fight, a time when remote learning digitized education and, especially, school, elements of the analog and digital subcultures directly influenced the crossing of cultural frontiers between science and the quilombola, indigenous, sertaneja and urban cultures of the students. In other words, it has impacted learning and can select some and exclude others for the lack of inclusive, intercultural, and socially responsible cultural mediation.

ANALOG AND DIGITAL SUBCULTURES IN EDUCATION

The Collins Dictionary (2023), brings in one of its definitions for the word ‘analog’ (American English word ‘analog’ is a variant spelling of British English ‘analogue’) as being an adjective “technology involves measuring, storing, or recording an infinitely variable amount of information by using physical quantities such as voltage; of or using an analog computer; using hands, dials, etc. to show numerical amounts” and defines the ‘digital’ word as an adjective that means “Digital system record or transmit information in the form of thousands of very small signals; digital devices such as watches or clocks give information by displaying numbers rather than by having a pointer which moves round a dial; its opposite

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to analog; performed using electronic devices such as computers and mobile phones". In this case, it is clear the opposing sense that analog and digital subcultures assume, being able to influence cultural development.

Lévy (1999) calls digital culture as cyberculture. Lopes and Schlemmer (2017) name smartphones and tablets as Hybrid, Mobile, and Wireless Digital Technologies (HMWDT) and value them as textual, imagery, video, hyperlinked, and interactive means of multimodal communication, typical of digital media. Quintela (2018), on the other hand, states that the digital place is known as cyberspace and is responsible for supporting intellectual technologies that amplify, externalize and modify numerous human cognitive functions: memory (database, hyper documents, digital files of all kinds), imagination (simulations), perception (digital sensors, telepresence, virtual realities), reasoning (artificial intelligence, modeling of complex phenomena). In addition, the author highlights the Internet of Things (IoT) and smart equipment such as unmanned cars, programmable home appliances, robots, as well as the cell phone that increasingly amalgamate auxiliary functions in the human routine.

According to Lopes and Schlemmer (2017), research involving the use of computers in Brazilian schools began in the 1980s and, with technological progress, left the interface of personal computers, reaching the Digital Information and Communication Technologies (DICT) and their multiple forms of online interaction through various devices.

Following the evolution of digital technologies Quintela (2018) states that it is necessary to reflect deeply on the school project in contemporary times and the school of the future, rethinking teaching practices, school cultures and digital technologies as foundations for innovation in school. In agreement with the urgent concern with a digital school culture, Tomé (2019) considers that digital technological advancement is the consequence of the rapid obsolescence of political, economic, social and cultural predictions and forecasts, challenging society and education.

In contrast, Lopes and Schlemmer (2017) make a counterpoint about the urgent need to turn the key from analog to digital culture. According to the authors,

> It is common to find research published in journals and annals of events that problematize the use of digital technologies without establishing a broader dialogue with the field of education research. [...] inevitably, a more judicious look at the production of knowledge in this field will end up characterizing it or classifying it as immediatist and/or linked to the trailer of the technological market or the hardware

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> and software industry. (Lopes & Schlemmer, 2017, p. 47).

Quintela (2018) criticizes today's school, since it

> was built based on the process of exploratory colonization, in which we were taught to arm and perform, read and copy, write the dictation, and be a student equal to all the others who were in the square rooms with chairs lined up one after the other. (Quintela, 2018, p. 24).

This position of the author imposes on us the reflection on the role of overvaluation of digital culture since it is a symbol of modernity and the urban. The use of remote teaching, even if punctual and temporary, portrays a condition of colonization by imposition of the digital subculture that could not be appropriated by other cultures.

This point is what makes us understand and assume, in this work, the analog and digital cultures as subcultures according to Aikenhead (1996), since they cross and constitute other cultures and are also susceptible to resistance or acceptance that represent the crossings of cultural borders. Thus, indigenous cultures and quilombola, although based on the analog subculture due to the oral tradition of preserving traditional knowledge, manual labor, utensils and body paintings and their dances and musicality, can develop digital culture. Analog and digital subcultures are therefore not determinant about ethnic-racial cultures, but subcultural actions by which they express themselves. And simply superimposing digital culture on the ethnic-racial cultural essence – without reflection – will replicate colonizing effects that value, for example, the urban over the rural.

Aguilar et al. (2013) realized that the analog and digital cultural relationship, as well as any other culture, produces tensions when articulated. These researchers, in a study related to the intercultural investigation between analog and digital in Spain, considered the exposure to available technologies (which they called technological density), interaction with technological resources (devices and Internet), the perception of students, parents and teachers about the digital system and, finally, digital competence in the classroom.

About this relationship between analog and digital, Rondini, Pedro and Duarte (2020) highlight the intercultural relationship of teachers who are culturally challenged when they use technological tools to pedagogical practice, associating the context of cyberculture with didactics, to teach the generation born in the digital age. Such cultural impacts have revealed themselves with intensity during the Covid-19 syndemic.

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In a study developed by Santos de Aquino et al. (2021) remote teaching was analyzed, and the authors realized that the remote teaching model has as objectives the regimental, normative and regulatory compliance that makes it dedicate itself primarily to the teaching process forgetting learning. This preliminary study motivated the proposition of a digital educational device as opposition to remote teaching established in Brazil, aiming at valuing the process of learning/construction of concepts and meanings traditionally neglected in the remote teaching model.

In this work, we consider the concept of multiculturalism of Candau and Moreira (2008), which classifies multiculturalism into three types: assimilationist, differentialist and intercultural. For the authors, multiculturalism is a relational process between cultures. Be it through the overlapping of a dominant culture that invisibilizes and nullifies another minority culture, such as the assimilationist type; either by the relationship of acceptance and sociocultural differentiation that guarantees its own spaces, but not included, as in the differentialist type; or interculturality, portrayed by democratic freedom and plural conviviality.

Intercultural relations are established through crossings of cultural borders, which do not always represent a territorial border that divides two regions or two countries, but cultural and symbolic borders (Matos; Caraballo; Acioly-Régnier, 2019).

IMPLICIT STATISTICAL ANALYSIS - ISA

The ISA is used in this study as one of the quantitative methods integrated into the mixed methodological strategy, which combines qualitative with quantitative method, and which will be described in the methodology.

According to Santos de Aquino (2021), ISA is in continuous expansion and development being applied in several areas and studies of the statistical theoretical framework, such as the integration of it with other statistical methods or its application in other scientific areas such as computer science, social, mathematics, scientific decisions, and intercultural education, concept construction and epistemology.

ISA is defined by Gras and Régnier (2015) as a theoretical field centered on the concept of statistical implication or, more precisely, on the concept of quasi-implication to distinguish it from logical implication and mathematics. The development of ISA is based on the need for statistical instruments that respond to the specificities of scientific areas that naturally found it difficult to use and establish quantitative methodologies. This makes ISA a theoretical field

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concerned with the union of qualitative and quantitative natures, as Gras and Régnier (2015) state that its theoretical development was stimulated by a dialectic between practice and theory, within a tension between two frameworks, statistics applied to something and mathematical statistics within various scientific fields such as the didactics of mathematics, psychology, sociology, bioinformatics, etc.

Wilhelmi et al. (2021) state that ISA does not necessarily present cause-and-effect relationships, that is, in general, ISA does not represent causality, but an inclusive relationship of variables. The relationships between the variables express the extraction of knowledge, invariants, and attribution of a measure to propositions of the type: 'when A is chosen, one tends to choose B' (Almouloud, Gras & Régnier, 2014, p. 625).

According to Cavalcante et al. (2016), this theoretical field has been developed for more than 30 years, including the creation and development of data treatment and analysis software called CHIC® (*Classification Hiérarchique Implicative et Cohésive* in French; meaning Hierarchical Implicit and Cohesive Classification), which is currently in version 7.0. For Freitas et al. (2019), the CHIC® has as functions: extract from a set of data crossing subject and variables (attributes), rules of association between variables; provide an association quality index; represent a structuring of variables through these rules. Valente and Almeida (2015), also highlight the ability to produce different models revealing rules of associations, providing probabilistic indices that quality them.

The interpretation of the data is performed through implicit graphs, which are generated through the calculations made by the CHIC® software applying, according to the choice of the operator, the classical or entropic implicit analysis, the binomial law considering or not the “significant nodes”. The implicit graph presents text boxes representing the study variables connected by vectors in different colors, where each color indicates an implication index. The implication index is a statistical-probabilistic value of the ISA, whose maximum value is 0.99, which in the implicit graph, indicates the strength of a given relationship between variables. The higher the implicit index, the greater the tendency for the relationship between the variables to occur.

Such characteristics presented allow to classify the ISA as a theoretical field of applied statistics whose nature of the data is quantitative probabilistic, where reliability is indicated as a trend through the implication index, the interpretation of the data instead of deterministic is possibilist, allowing the description and understanding of the dynamics of the data as a momentary phenomenon of the reality, as pointed out by Santos de Aquino et

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al. (2021). Another relevant factor is that the ISA does not preclude studies of small sample universes, nor the use of qualitative data, as occurs with traditional statistical methods. This allows flexibility and statistical rigor to studies in the area of human sciences.

METHODOLOGY

Hypothetical-deductive empirical research of a mixed analytical nature in which the planned articulation of qualitative and quantitative methods is considered. It is part of the doctoral thesis “Teaching Science in Cross Culture: the formation of concepts in a multicultural classroom in Salgueiro, Pernambuco, Brazil” published in 2022.

Ethics in research

The research was ethically appreciated and approved and registered under CAAE number: 32536620.2.0000.9547 in the ethic research analytic system of Brazil (CEP/CONEP).

Context

The work is part of a doctoral study conducted at the Federal Institute of Sertao Pernambucano (IFSertãoPE), Salgueiro campus, during the period of the Covid-19 pandemic. Constituting the sample universe, 14 students participated, being 4 indigenous Atikum and Truka, 1 quilombola, 5 sertanejos and 4 urban belonging to the 4th Year of High School Integrated to the Agricultural Technician aged between 16 and 18 years of age. The students were coded according to the culture to which they belong: Sertanejos (RS1, RS2, RS3, RS4, RS5); indigenous (RIA1, RIA2, RIT1, RIT2); quilombola (RQ); and urban (RU1, RU2, RU3, RU4).

Digital didactic-pedagogical intervention

The intervention took place through an extension course, applied virtually, entitled “On the Milk Trail” with the objective of investigating learning in the multicultural classroom in a proposal of digital education planned with synchronous and asynchronous stages and based on principles of complexity, interculturality, decoloniality, inter and transdisciplinarity with a focus on the teaching of biochemistry.

The proposed didactic-pedagogical and digital device, called “On the Trail of Milk”, was developed for asynchronous moments and is a didactic sequence of asynchronous digital mediation structured on the Miro® application. On the whiteboard of Miro® was inserted a

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board that connects the European continent to the Brazilian Northeast passing over Africa. On the trail, there are balloons that provide guidance and hyperlinks from other media and applications (Kahoot®, Canva®, Padlet®, access links to the videobook “On the Trail of Milk” and in the problematizing and contextualized animations built with Animaker.com®). The proposal presented requires the student to develop a digital culture based on the autonomy of activities and learning that is mediated through the interaction of students with the device. The skills belonging to the analog culture were also considered in this proposal because they reveal skills built through the sociocultural framework of the students. In other words, there are boundaries between digital and analog, between students’ diverse ethnic cultures, and between school and out-of-school cultures. This condition exposes the challenge for a conceptual learning that reconciles know-how-say and know-how-do integrating cultural specificities.

Mixed method

Qualitative data were collected and analyzed in the first stage of the research that was incorporated into data construction and quantitative analysis and in sequence the ISA as a secondary quantitative method. This characterizes the mixed methodology as concomitant incorporated [QUAL(QUAL)→quan] according to Santos et al. (2017).

Qualitative method

The qualitative analysis was based on two aspects: (1) the identification of the subcultural profiles of students as analog, digital or intermediate according to the principles of Aguilar et al (2013) in relation to the student's perception of their digital competence and technological interaction; (2) the conceptual construction in biochemistry according to Couto et al. (2017) regarding the misguided, gaping and coherent conceptual constructions.

The identification data of the subcultures from Aguilar et al. (2013) were constructed from observations through school productions, mediated by the interaction with the digital didactic-pedagogical device “On the Trail of Milk” and during synchronous classes on Google Meet®.

The construction of data regarding the construction of concepts in biochemistry took place through the analysis of the students' productions when answering the question “what is photosynthesis?”, being classified according to Couto et al. (2017).

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Quantitative method

Two quantitative analytical methods are employed in the study: (1) frequency by dispersion and (2) Implicit Statistical Analysis (ASI). These methods complement each other because they help in the holistic interpretation of the results.

Frequency analysis by dispersion

Initially, we used the observable characteristics of the analog and digital subcultures according to the principles studied by Aguilar et al. (2013) to create a quantification system based on the frequency of observations of these characteristics. The principle of the technological density of Aguilar et al. (2013) was verified through the students' statements about the technological resources used in remote teaching.

Among the principles of identification of the analog and digital subcultures of students that were worked by Aguilar et al (2013), we highlight the perception of the student, the digital competence, and the technological interaction. The perception of the student refers to the understanding of himself when using the instruments for the execution of the digital school activities, which for us was configured with their opinion about whether or not they were adapted to remote teaching. Digital competence does not refer exclusively to knowing how to use technological instruments, but to the transformation of the scientific object in the process of knowledge construction, being identified by the analysis of students' resourcefulness with the digital system. Technological interaction is evaluated between the student's interaction with the digital system (hardware and software) and digital interpersonal interaction, which we classify as high or low. Each identified characteristic received a score between 0 and 2, so the digital or analog influence scores could be quantified individually on a scale between 0 and 10 points. This allowed the crossing of the scores of each subculture that constitute the student and the identification of the subcultural profile. The description of the quantification system for frequency analysis by dispersion is shown in Table 1.

Table 1. – guide to the analysis of analog and digital subcultures in the cultural constitution of students

Principles of Aguilar et al. (2013)	Analyzed characteristics	Identified characteristics	Subculture
Students' perception	Declaration of the adaptative process	Adapted	Digital
		Not adapted	Analog
	Resourcefulness	Resourceful	Digital

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Digital competence		Not resourceful	Analog
	Execution of activities	Digital through apps	Digital
		Handwritten and handmade	Analog
	Resignification of the object	Happened	Digital
		Did not happen	Analog
Technological interaction	Level of difficulty	Low difficulty	Digital
		High difficulty	Analog

Source: Authors.

Each of the students had their profile of performance in the asynchronous modality evaluated according to the subcultural characteristics. We analyzed the individual productions arranged on the device, as well as the synchronous records of the Google Meet® videoconferencing platform, in order to identify student expressions about the use of the device that portrayed difficulties or surgical facilities, among others.

After the characterization and analysis of the subcultural profiles of each student, we used quantitative analysis by dispersion to identify the students' position regarding the process of digital and analog enculturation. To do so, it was necessary to create a scatter plot through Microsoft Excel 365®, in which the Y axis represents the value obtained from the digital subculture, while the X axis represents the analog subculture. The crossing of each of the values represents the positioning of students in the subcultural universe between analog and digital.

Implicit Statistical Analysis - ISA

Besides the quantitative analysis expressed by the scatter plot, we also used the Implicit Statistical Analysis – ISA (Gras & Régnier, 2015) to analyze the analog and digital subcultures as a function of the socioeconomic and cultural conditions of the students. The information was obtained using a questionnaire based on the model of the intercultural informative triad of Kidman, Yen and Abrams (2013) that was applied to each student in the format of an interview through Google Meet®.

Regarding ISA, we used the implicit graph generated in cone mode to understand the implicit relationships with the subculture variables “digital” and “analog”. A graph is the representation of sets, objects, or variables related to each other through vertices or nodes. It is a mathematical representation of graph theory. And the cone mode is an implicit analysis tool that provides the generation of implicit graphs that centralize the implicit relations in one or more variables chosen due to the importance of the study. In this work, the variables of the subcultures “Analog”, “Digital”, and the intermediate stage between

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them “Intermediate” were our focus of implications.

We consider the implication index of 0.70 with statistical calculation based on “significant nodes” and implication according to classical theory and binomial law. The implication index is a probabilistic-based statistical value that quantifies the relationships between two variables on a scale from 0.1 to 0.99. The closer to the value 1, the stronger the implication relationship between the variables; the closer to 0, the weaker the implication relationship between the variables.

The data, organized in binary values, and arranged in Excel® spreadsheets, were treated through the software CHIC® 7.0 (2014). The variables are classified into four groups: (1) Cultural, variables: “Sertanejo”, “Urban”, “Indigenous”, “Analog” and “Digital”; (2) Social and economic characteristics, variables: “quota holder”; student in socioeconomic difficulty “Socioecono_hardship”; rural housing region “Farm” or urban “City”; student who receives school financial aid “Aid”; lives with children at home “Lives_with_child”; works in rural activity “Field_work” or develops domestic work in his own house “Domestic_work”; (3) Technological characteristics, variables: having received the aid for remote teaching “Remote_teach_aid”; sharing electronics to study “Share_eletr”; exclusive use of computer to study “Uses_comp”; exclusive use of cell phone to study “Uses_cell”; environmental connection disturbances such as “Environm_disturbance” ambient noises or oscillation and drop of the Internet signal “Internet_disturbance”; (4) Perception of adaptation to remote learning “Adapted”, not adapted “Unadapted” or in adaptation “In_adaptation”.

RESULTS AND DISCUSSION

Considering the dynamics established between the analog and digital subcultures in the syndemic and digital school environment, as well as accepting the influences that they can exert in the teaching and learning process, we seek to launch an intercultural look that does not impose the homogenization of a given audience nor the hierarchization of cultures. Culture, as pointed out by Vygotsky (1999) is established by the exposure of the individual with his environment and consequently with all the factors that contribute to the conceptual construction, which will later constitute the psyche and praxis establishing the culture that will follow the cycle of cultural constitution in a society or social group.

Qualitative analysis: externalizing subcultures

Figure 1 shows that most urban students (RU) have stronger characteristics of the digital

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subculture, while indigenous students tend to be more analog and students from the sertaneja and quilombola present themselves with intermediate characteristics between coherent conceptualization and digital subculture, while analog subculture is more implicated with mistaken conceptualizations. The conceptual gap is defined by Couto et al. (2017) as incomplete and represents the dynamics of the conceptualization process as a stage of conceptual construction.

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Figure 1.- the subcultural analog and digital constitution of students related to the process of construction of concepts in biochemistry

Student	Subcultures			Biochemistry Conceptualization		
	Analog	Transient	Digital	Mistake	Gap	Coherent
RU1						
RU2						
RU3						
RU4						
RS1						
RS2						
RS3						
RS4						
RS5						
RIA1						
RIA2						
RIT1						
RIT2						
RQ						

Source: own authorship

It is perceived, in the figure, that there is a relationship between the analog and digital subcultures with the conceptualization process. We identified a tendency of digital and intermediate culture to relate to coherent conceptualizations while analog students tend towards conceptual misconceptions in biochemistry. In the subculture column, we notice that the analog subculture is represented by a light blue coloration, while the digital one is dark blue, however, between them, there is a transient representation in which the student is influenced by both subcultures and is represented by the transition from light blue to dark blue indicating the transient subculture.

These initial data show us that in a completely digital didactic-pedagogical proposal, the subcultural constitution of the student was fundamental for the conceptual construction. Although the methodological design has sought to move away from remote teaching, planning the instruments and scientific knowledge from the students' extracurricular culture, we observed that learning is affected by the subcultural base being hindered for analog students.

It is worth mentioning that the school culture itself is still analog. The transition to digital culture has been better established for bureaucratic, management or procedural directive activities such as enrollment and processes. However, the actions of digital enculturation in the didactic-pedagogical scope, more precisely on the curriculum, still present resistance linked to the lack of technological structure and the strong analog constitution. On this, Nonato, Sales and Cavalcante (2021) state that the school and the subjects that constitute it remain analog in an increasingly digital world, although school digitization has advanced

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in the directive and non-interactive uses.

Although rosa (2013), who in her thesis work investigated scientific learning through a digital didactic-pedagogical project at the school of Application in the city of Porto Alegre, Brazil, has presented promising results, we highlight here the author's statement that "digital culture shows that opposition between culture and technology has no foundation" (p. 49). Considering that the author attributes such opposition to reductionist thinking or interpretation that separates complex technological relationships, reducing them to mere tools, without considering human interaction and relations. Our results show that digital culture can indeed be in opposition between cultures and technologies, and that cultural standardization within schools is a historical reality (Nonato, Sales & Cavalcante, 2021; Santos de Aquino et al. 2021). This opposition is evidenced in the learning difficulties that are the result of intercultural relations, where digital culture has even superimposed on the cultures of students, promoting a new cultural domination in current times, placing the digital subculture alongside other dominant cultures such as urban, considered modern, over the rural culture that is considered backward.

Furthermore, we cite Scavino and Candau (2020) when defending that the digital generation is not necessarily digitally literate, since the experiences of children and young people is marked by spontaneity through the search for leisure, use of games, the mastery of different applications that promotes a digitally enriching experience, but not developed in a reflective and critical way. Therefore, believing in a completely digital generation would be a mistake, simultaneously with a colonial practice that disregards the rich and diverse traditional cultures of strong analog constitution such as that of indigenous, quilombolas and sertanejos.

This relationship, evidenced by Scavino and Candau (2020), is an example of Rabardel's (1995) instrumentation and instrumentalization processes. While instrumentation allows the learning of artifacts and their simple useful application, instrumentalization, which occurs through human-instrument interaction, allows the transformation of the object, allowing resignification. That is, just knowing how to use the instruments does not mean literacy, nor instrumentalization.

A curriculum based on digital education called the web curriculum (Lopes & Schlemmer, 2017; Quintela, 2018; Rose, 2020; Nonate, Sales & Cavalcante, 2021), should consider the most basic intercultural relationships between analog and digital subcultures, as well as the cultures they constitute such as those we evidenced in this study. For Acioly-Régnier (2008)

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and Acioly-Régnier and Barraud (2012), a technical instrument does not automatically become a psychological instrument, because for this to occur it is necessary to consider the associated schemes, those that students bring with them from the extracurricular culture. These intercultural nuances represent the perception of the intercultural dynamics between the digital and analog subcultures in this study.

Quantitative analysis

In this stage, we resort to two quantitative analytical types: the first, is the study of frequency by dispersion; the second is the ISA applied to the variables related to each subculture.

In the first part, we sought the quantification of the observations to characterize the most representative subcultures in each student. This allowed the construction of the scatter plot that positions the student subcultural profiles in a Cartesian plane representing the dynamics between the analog and the digital.

With ISA, we take a look at the variables that relate to the analog and digital subcultures, and the strength of these relationships through the indices of implication. Implicit relationships reinforce verified relationships or denote those that were not perceived qualitatively.

Frequency Analysis: dynamics of the subcultural constitution

Under these considerations we present the dynamics of intercultural formation in consideration of analog and digital subcultures among indigenous, quilombola, sertaneja and urban students. We visualize the subcultural profile in the intercultural dynamics of subcultural profiles in the multicultural classroom in Salgueiro-PE is presented in Figure 2.

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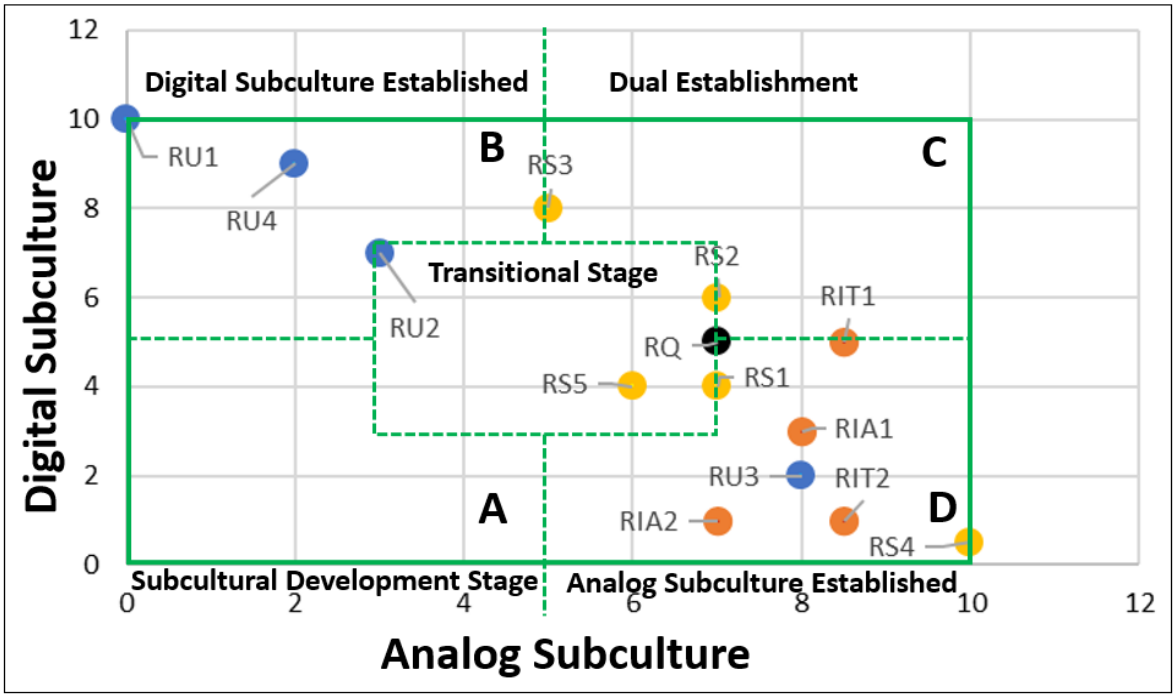
Figure 2: intercultural dynamics from the analog and digital subcultural profiles of students in a multicultural context.



Source: own authorship. Chart built with Microsoft Excel 365® and modified with Paint 3D®.

Figure 2 shows the scatter plot where we can visualize the positioning of the analog and digital subcultural profiles of each student with the area of the Cartesian plane delimited in a green line. This allowed us to identify areas of subcultural constitution that, although quantified, represent a dynamic process as student experiences contribute as part of the intercultural process.

This area is subdivided by green dotted lines that represent quadrants of subcultural profiles, represented by the letters A, B, C, and D, and a sub-quadrant delimited by a green dotted line that represents a transient stage area between analog and digital cultures.

Quadrant A is equivalent to the analog or digital subcultural development stage. This quadrant appears without records of subcultural profiles because it represents a stage of cultural initiation. The participation of adolescent students refers to some appropriation of the studied subcultures. Thus, we could have some sample positioning in this quadrant if there was the participation of students who do not yet have experienced or have not been exposed enough to the digital subcultural environment to express the appropriate characteristics.

Quadrant B represents a stage of establishment of the digital subculture, where the

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positioning of urban students (blue dots) is observed. This data means that students of urban culture tend to develop the digital subculture more strongly. Some socioeconomic factors of this group enable this type of behavior, such as greater access to technologies (more modern laptops and cell phones with better Internet service) as well as better family conditions (living with fewer people at home, having a place to study in the bedroom, less need for work to help family conditions, among others).

Quadrant C represents the double subcultural profile when a given individual presents characteristics of the subcultural establishment of both the analog and digital subcultures. We verified in this quadrant the approximation of students to the limits of this quadrant, mainly by the sertanejo students, as well as the quilombola and indigenous students.

A dual subcultural profile favors the multipurpose skills between the analog and digital domains. It is a condition of intercultural development between the two subcultures. This enhances the learning conditions between two worlds, traditionally represented between the world of the analog teacher and the digital student. Although this traditional representation is not applicable to our study, since not all students born in the Digital Age have skills from digital enculturation.

Quadrant D represents the establishment of the analog subculture and reveals a tendency toward the cultural constitution of indigenous Atikum and Truka, mainly. The indigenous cultures involved in this study present analog expressions and materializations such as orality, crafts, body designs, and dances, among others. In addition, these students present socioeconomic characteristics different from those that constitute urban students, such as inaccessibility to the technological resources required for digital education, more inhabited homes, and the absence of domestic environments for study.

The intercultural dynamics of these results allow us to evoke Piaget (1950), Acioly-Régnier (2019), and Rabardel (1995); the first, Piaget (1950), due to the consideration of the adaptation process, because in an educational practice that breaks with the analog culture assuming the digital, students are confronted with stimuli of new objects (electronic devices, software and multimodal contents) that necessarily lead them to the creation of new schemes or the modification of old schemes for the broader adaptive balance. The second author, Acioly-Régnier (2019), theorizes about cultural, cognitive, and affective approaches, arguing that the construction of scientific concepts is based on the practical value in the lives of students that occurs through the intercultural interaction between extracurricular and school culture. This factor was disregarded in remote learning both by the denial of cultural

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diversity and consequent exclusion of minority cultures and the non-consideration of the analog subculture of students. The third author, Rabardel (1995), considering computational education, proposes the consideration of the instrument as an entity of the processes of instrumentation and instrumentalization, which are requested simultaneously with the evolution of the instrument also of conceptualization. For him, instrumentalization is oriented to the artifact and instrumentation to the schema component of the instrumental entity, configuring itself as an expanded instrumental mediation.

With the above, we want to argue that intercultural relations in digital education can affect the process of knowledge construction, constituting in this case, barriers that prevent adaptation and conceptualization when analog students are inserted in a digital curriculum. Quintela (2018) while studying the impact of digital education policies and projects in Brazil realized the existence of conflicts between cognitive regimes – analog and digital – that were not producing appropriation or reconfiguration of practices, a fact that had already been identified by Aguilar et al. (2013) in Spain. Rosa (2013) also reinforces that the absence of technological resources such as computer and quality Internet impacts the digital enculturation of students, since she verified better results of school digital enculturation in students who participated in the program one computer per student called “one for one” when compared to those who shared the instrument with another colleague at school.

ISA: implications of Subcultures

The ISA provided the investigation of implication relationships related to analog and digital subcultures, as well as the transient condition between them. Figure 3 shows the relationships implied to the analog subculture.

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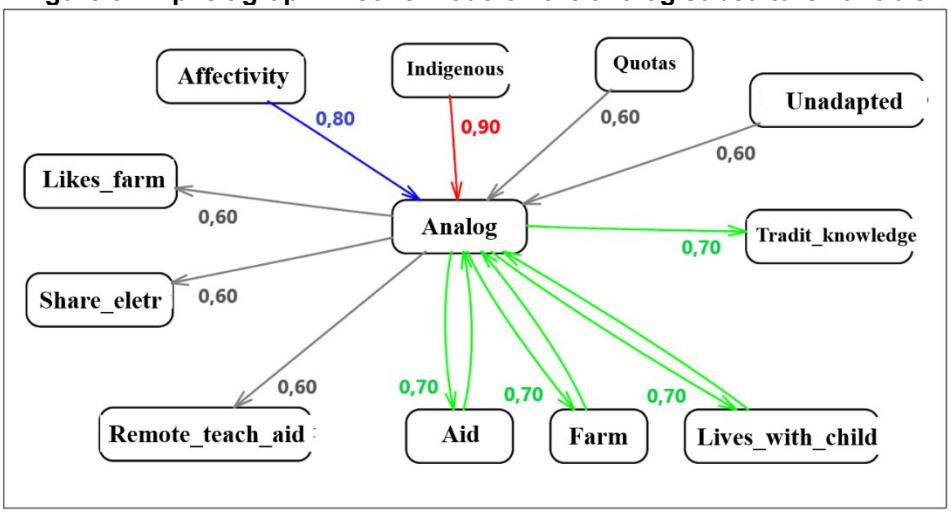
Figure 3: implicit graph in cone mode on the analog subculture variable



Source: Software CHIC V. 7.0 (2014).

In the implicit graph it is verified that the indigenous culture tends to express itself analog way, under an implication index of 0.90, meaning a strong trend among these variables (Indigenous→Analog). This relationship was perceived in the scatter plot in Figure 1, reinforcing the result. In addition, there are other relations of the implication that translate the socioeconomic reality of indigenous students that also imply or suffer implications of the analog subculture. For example, quota students (Quotas→Analog), students who receive student aid (Analog→Aid), who received specific aid for remote teaching to fund Internet packages or repair cell phones and laptops (Analog→Remote_teach_aid) and that the analog subculture tends to be expressed by students who share electronics (cell phones or laptops) to study during the remote mode (Analog→Share_eletr). Analog students still tend to be from rural areas (Analog→Farm), they like agriculture which has a practice of strong analog bias (Analog→Likes_farm) to the peasant conditions of family farming (common characteristic of students in Salgueiro), there is the conviviality with children at home (Analog↔Lives_with_child) which supports the fact they share the same smartphone to study during the period of remote teaching.

The social conditions that prevent access to the technologies necessary for remote teaching and the activities of the digital cultural world contribute to the non-development of digital culture. This can also be noticed when students who said they were not adapted to remote learning tend to have stronger characteristics of the analog subculture (Unadapted→Analog). Digital enculturation depends on exposure to the digital medium, necessarily through technological resources of considerable capital value, inaccessibility

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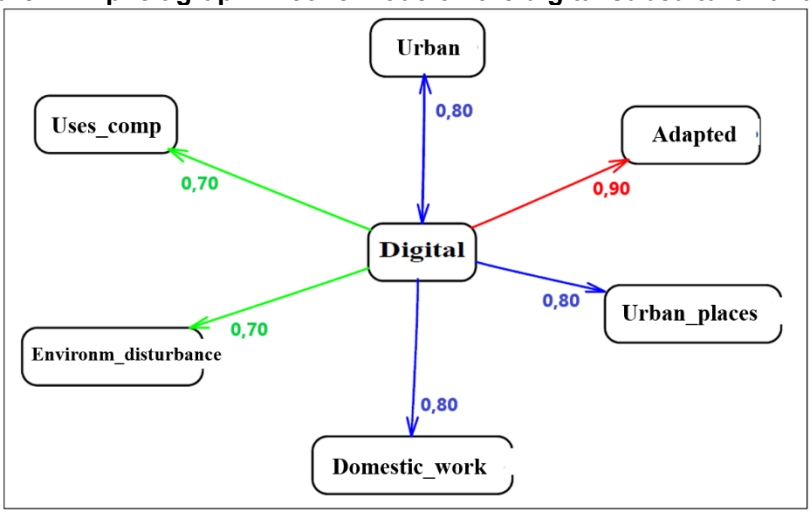
contributes to the non-development of digital culture. In addition, the realities of indigenous students inhabiting villages and rural territories is of low-quality Internet service.

Another important relationship to highlight is that indigenous students revealed a greater appreciation of affective aspects (data obtained through the questionnaire) in their social bonds, such as the attention paid to students, equal treatment for all and friendship. These relationships also reflect the analog culture of contact and social interaction in the classroom, as it was before the health crisis. Therefore, the relationship between these variables appears in the graph (Affectivity→Analog).

Figure 4 shows the implicit graph referring to the digital subculture (Digital). In it, the double implication between the variables (Digital↔Urban) is highlighted, under as implication index of 0.80. This confirms the data presented in the scatterplot in Figure 1 positioning urban students in digital culture.

Figure 4: Implicit graph in cone mode on the digital subculture variable



Source: Software CHIC V. 7.0 (2014).

We observed that students who present characteristics of the digital subculture tend to use computers to study during remote teaching (Digital→Uses_comp), and that under a high rate of implication (0.90), they tend to be students declared to the remote teaching model (Digital→Adapted), and that the disturbances measured in the interview by videoconference were of the environmental type, noises coming from the domestic or urban environment, there are no problems of interruption of the internet signal (Digital→Environm_disturbance). The type of work of digital students is domestic, assisting parents in home activities (Digital→Domestic_work), a work activity that does not reflect in financial contribution to family income such as characteristics of indigenous, quilombola and sertanejo students.

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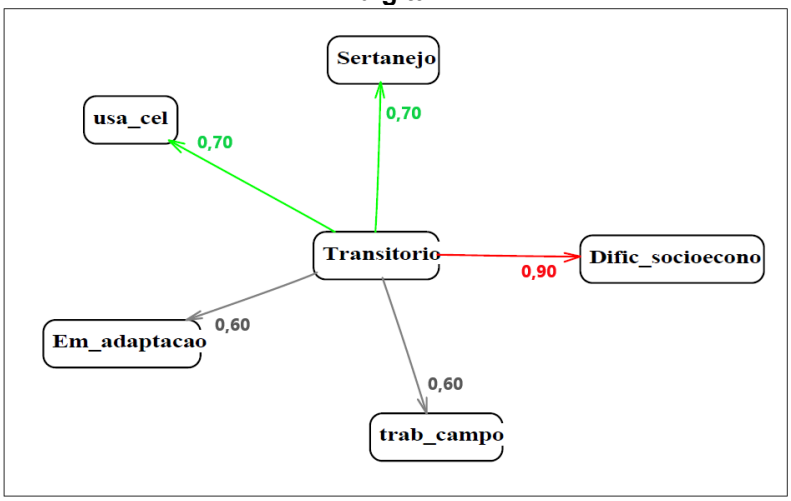
The socioeconomic conditions of urban students favor the development of a digital culture. In Figure 5, we observe the implicit relationships related to the transient subcultural characteristics between digital and analog. Students who present balanced characteristics between analog and digital subcultures tend to be sertanejos (Transient→Sertanejo), a result that also reinforces the data presented in the scatter plot.

Figure 5: Implicit graph in cone mode on the subculture variable in transition between analog and digital



Source: Software CHIC V. 7.0 (2014).

The variables listed in the previous implicit graph present socioeconomic characteristics that translate the students of the sertanejo culture. The transient subculture implies students with socioeconomic difficulty (Transient→Socioecono_hardship), perform agricultural work on the family property of small farmers (Transient→Field_work), are students who tend to use the cell phone to study during remote teaching because they only have the cell phone to study (Transient→Uses_cell) and declare themselves to be in the process of adapting to remote teaching (Transient→In_adaptation).

In a global analysis, the results show that analog and digital subcultures influence the process of adaptation to the remote teaching model antagonistically, where analog hinders crossing the border to digital affecting the teaching and learning process. Even in the condition of a digital course, not configured as remote teaching, there were adaptive difficulties dependent on the student cultures that influenced the fulfillment of tasks, the form of materialization of the tasks, when only textual productions were carried out in digital media, but other productions such as schematics and drawings were developed by hand and photographed revealing the analog nature of the students' skills. The execution and

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tasks at hand reflect the absence of digital resources or the lack of knowledge for their production, but above all, it is influenced by digital inabilities or incompetence among the know-how originating from the extracurricular culture that is loaded with analog cultural instruments. On the other hand, the execution of the activity by hand and the digitization through photography by cell phone and the insertion of this digital material in the device can represent a process of hybridization and consequent adaptation between the subcultures.

FINAL CONSIDERATIONS

The Brazilian educational process must be rethought regarding the reforms and adaptations that aim at a digital, inter, and transdisciplinary education, but above all that starts from the cultural realities that represent all the Brazilian diversity. Their recognition begins by thinking of a non-homogenizing education. The standardization of Brazilian audiences favors the invisibility, appropriation, and historical subjugation of the many cultural expressions in our country.

Research in science teaching, today, must assume this intercultural perspective that reveals not only habits, beliefs, and behaviors, but also expresses diverse cognitive structures that must be known and recognized by the school and the teacher in favor of equitable and egalitarian teaching and learning.

In the multicultural classroom in which we developed our study, the conditions of enculturation of a digital subculture at a peculiar moment in our history, in which the school left the analog world to become digital, left important marks that will take years to be deeply understood. The Covid-19 syndemic has imposed on us socio-economic segregation through a cultural imposition that depends exclusively on the socioeconomic well-being conditions of our society. The unequal access that our students have concerning technologies necessary for remote learning has reproduced and deepened social inequality in the school environment.

Through our results we can highlight the following final considerations:

1) the student materializations are influenced by the cultural abilities of the students, with the indigenous group having a greater tendency to analog activities possibly influenced by cultural productions based on orality and culturally defined manual work;

2) indigenous, quilombola, sertaneja and urban cultures present determinant socioeconomic differences for the digital subculture;

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3) the use of cell phones as the main means of digital development, by indigenous and sertanejo students, tends to hinder the process of adaptation to remote teaching, as well as the use of laptops favors the adaptation to digital teaching, as is the case of urban schools;
4) the sharing of electronics to study among the student and other family members tends to hinder the adaptation to the digital subculture;
5) the development of a digital culture depends on the cultural framework of the student because there are differences in this development according to the cultural type to which they belong;
6) The digital subculture can act as the dominant culture assuming a colonizing posture subjugating the analog subculture constituent of the minority cultures contributing to the sociocultural exclusion in the school.

Based on these considerations, we defend a proposal for innovative digital education that considers not only the cultural conditions of students, which includes respect for the conditions of digital enculturation as well as the availability of technological, material, infrastructural, and didactic-pedagogical resources. Consequently, the student cultural realities that govern the skills and competencies of materialization of school activities will be favored in the construction of knowledge.

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