Collaboration in Computing Education: Equity and Self-Directed Learning from the Global South*

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Abstract. *Collaboration in Computing Education concerns the reflection of equitable variables like gender, race/ethnicity, socioeconomic status and culture. However, addressing how to balance different sources of inequities is still an open challenge. Active learning and Self-Directed Learning (SDL) have the potential to create a more equitable educational environment, promoting more autonomy and crucial soft skills for students in our complex society. Understanding better how SDL effectively occurs in computing students can also contribute to comprehending the potential of active learning in terms of capabilities approach (CA), a solid equity theory. Thus, this doctoral research investigated how computing students conduct their SDL in developing countries from the CA lens. The results are structured over the perceptions of two Brazilian computing undergraduates about their SDL trajectories, being each one from the lowest and highest socioeconomic status of their class, respectively. Interviews and other data sources helped to better situate the findings. The doctoral contributions were in (i) the use of CA as an equity theoretical framework in computing research, and computing education, (ii) the proposition of a new concept called SDL capabilities, and (iii) a pragmatic instantiation of equity discussions in computing education (beyond other scientific contributions to Computing and Education in a general way).*

1. Subject Overview

Collaboration in Computing Education concerns the reflection of equitable variables. Various works in Computing Education (CEd), the broader area, approach equity issues like gender [Kim et al. 2011], race/ethnicity [Nakajima et al. 2024], socioeconomic status [Parker et al. 2018], and culture [Arawjo and Mogos 2021]. Equity and diversity also used to be two sides to a story in CEd, allowing us to see the same problem from these two perspectives [Lewis et al. 2019]. However, addressing how to balance different sources of inequities is still an open challenge.

A framework to address this problem is CAPE [Fletcher and Warner 2021]. This stands for 'Capacity for', 'Access to', 'Participation in', and 'Experience of'. This framework proposes a lens for assessing equity not only in Computer Science but in CEd as a

*According to the *Concurso de Teses, Dissertações e TCCs* Calling from the Brazilian Symposium of Collaborative Systems (SBSC), this summary paper did not require to be an original work. Significant parts of this summary can be found in this original paper [Bispo Jr. et al. 2025].

whole. Although CAPE can map most of the main variables to an equity analysis, the concept of capacity is strongly related to resources, ignoring some essential aspects relative to the real opportunities for a computing student.

Another framework that can address this problem is the Capabilities Approach (CA) proposed originally by Amartya Sen [Sen 1992] and improved by Melanie Walker [Walker 2006] for education purposes. This approach allows us to identify not only the resources that are supposed to be absent in inequity scenarios but also map the capabilities that cannot possibly be developed by a student. Other education fields use the capabilities approach (e.g., Geography [Walkington et al. 2018], but CEd still has explored its potentialities marginally.

The CA is a theoretical framework based upon two normative claims: (i) the freedom to achieve well-being is of primary moral importance, and (ii) the understanding of well-being is directly related to people's capabilities and functionings. The freedom of being educated is one of the aims of this perspective, understanding it as a part of the broad problem of liberating people for a fulfilling life.

In this direction, active learning can potentialize the freedom of computing students, promoting more autonomy and crucial soft skills in our complex society. Pedagogical frameworks and methodologies like andragogy [Ellis 2002], problem-based learning [Santos et al. 2021], and peer instruction [Bispo Jr. et al. 2021b] somehow develop the idea of active learning in this area. These approaches strongly dialog with the constructivism theory (which asserts that students "construct knowledge rather than merely receive and store knowledge transmitted by the teacher" [Ben-Ari 2001, p. 45] and, by consequence, with self-directed learning [McCartney et al. 2016].

In the Science, Technology, Engineering, and Mathematics (STEM) context, active learning pedagogies have been effective in promoting the increase of learning outcomes [Prince 2004]. However, collaborative pedagogies in the CEd context have led to marginalization [Lewis and Shah 2015] like over-dominance concerning student participation. Self-Directed Learning (SDL) is a potential equitable practice [Anderson and Beach 2022], but there are open challenges to consider regarding when and how to use it [Brookfield 1993]. Understanding better how SDL effectively occurs in computing students can also contribute to comprehending the potentiality of active learning in terms of capabilities.

In developing countries, other challenges emerge. Beyond the potential inequity sources that emerged from natural diversity in the classroom (e.g., gender, race), structural barriers deepen the situation (e.g., socioeconomic status, poverty). In African countries, for instance, it used the CAPE framework to analyze equity issues in CEd [Tshukudu et al. 2023]. Although the authors highlight the strengths of its use, they also point out some limitations:

> "The CAPE framework helps map the progression from 'Capacity for' to 'Experience of' computer science education as a route to equity, but in order to support development in low and middle income countries, it may be helpful to have the capacity level finely grained" [Tshukudu et al. 2023, p. 1].

Maybe the capability approach can help to fill some gaps during equity analysis using

only the CAPE framework.

In this way, the proposed research will help to establish a process to identify the crucial CEd capabilities in the context of self-directed learning in developing countries. The fundamental presupposition is to ensure fair and equitable CEd, mainly in the global south. However, how do we propose the actions and policies needed to mitigate and, if possible, eliminate the sources of unfairness from an interrelated and multifactorial perspective of equity issues (e.g., race, gender, socioeconomic status)? One way is to assess the educational scenario from the capabilities approach.

In this way, the main research question (MRQ) of this thesis is

(MRQ) "How do computing students conduct their SDL in developing countries from the CA lens?".

Three research goals (RG) help to address this question:

(RG1) understanding how computing students build their SDL trajectories in developing countries;

(RG2) mapping the main elements of SDL capabilities observed in computing students in developing countries; and

(RG3) recommending guidelines to (computing) educational stakeholders concerning how to consider effectively equity issues and active learning from the CA lens.

2. Related Work

There are various reasons to structure a related work chapter [Booth et al. 2016, p. 14]. For this project, I am interested in (i) locating my work within the existing literature and (ii) justifying its originality. Doing this in a qualitative investigation requires me to establish some considerations.

Although the expression "on the shoulders of giants" can represent a humble stance before the complexity and greatness of produced knowledge through scientific endeavor, it is possible to interpret it in a positivist way. The discussion proposed here does not intend to build one brick more in a cartesian wall of science. I propose to establish one more link to the big network of produced scientific knowledge. In this network, each node links a perception of reality historically, through dialogues with the contribution of colleagues situated in space and time.

In this perspective, it is necessary to run away from a kind of technicism that tries to specify and discretize every step of a given methodology. A hidden pitfall is to use this agenda to describe reality, just as it is, in a positivist way. What we need is a rigorous and, if possible, systematic description to explicit the main aspects of our methodological approach. A systematic approach in a qualitative research is not strictly a matter of reproducibility, like we try to replicate an experiment. However, it is a concern of rigor that legitimizes the quality of our research and allows other researchers to structure a possible transferability.

2.1. Scoping Study with Snowballing Strategy

A systematic mapping used to be a good starting point for further research [Kitchenham et al. 2011], including for Ph.D. studies [Kitchenham et al. 2010]. In this mapping, I follow the general framework of a scoping study [Arksey and O'Malley 2005],

considering the guidelines for snowballing in systematic literatures proposed by Wohlin [Wohlin 2014]. I will describe them better as follows.

The scoping study is a systematic mapping that aims "to map rapidly the key concepts underpinning a research area and the main sources and type of evidence available, [...] especially where an area is complex or has not been reviewed comprehensively before" [Arksey and O'Malley 2005, p. 21]. The methodological framework of a scoping study can be divided into five stages: (i) identifying the research question, (ii) identifying relevant studies, (iii) study selection, (iv) charting data, and (v) collating, summarizing and reporting the results [Arksey and O'Malley 2005, p. 22].

For identifying relevant studies (second stage), I use the snowballing strategy as the main road to locate additional papers to include for further selection and analysis. This inclusion can be via the reference list or the citations of a paper. The process of identifying new papers from the references' and the citations' list are commonly called backward and forward snowballing [Wohlin 2014, p. 1]. It is important to highlight that several computing education researchers use snowballing strategy in their systematic literature studies as [Qian and Lehman 2017], [Gomes and Matos 2020] and [Indriasari et al. 2020].

2.2. Summarizing and Situating Results

Research (DSRQ.1)

About DSRQ.1, most of the papers are primary works (29). There is only (i) one secondary paper [Lai et al. 2023] that reviews the broader area from the SRQ perspective and (ii) one essay [Michaelis and Weintrop 2022] that is usually in frontiers between primary and secondary categories. There is a reasonable balance between quantitative (10), qualitative (8), and mixed-methods (10) approaches. It was not possible to identify the research methodology in two papers [Michaelis and Weintrop 2022, Akalin et al. 2021] and the secondary work used the [Kitchenham and Charters 2007] guidelines.

I chose a primary and qualitative approach for this research project. This option reflects the research that looks for a better understanding of real scenarios when inequalities of opportunity can arise. I conducted a basic qualitative research using quantitative data to support triangulations and sampling choices.

Context (DSRQ.2)

In relation to DSRQ.2, the papers are balanced into higher (14, including graduate studies) and basic education (13, including high school and professional formation). The possible reason for this equilibrium is the inclusion of computing in basic education in many countries. The work of [Arawjo and Mogos 2021] is an example of an exception, focusing on informal education (3) too. Most papers investigate the research context in USA (16), followed by Asia (6), and Europe (5). Africa [Arawjo and Mogos 2021], Latin America [Roque Hernández et al. 2021], and Oceania [Shahin et al. 2022] have only one work each.

I investigated CEd context in this thesis. However, the Brazilian scenario brings a difference when focusing on developing countries. Only seven papers (of 31) have their contexts situated in the Global South[1]. Only one of them investigates Latin American

[1]I used the demarcation criteria adopted by BISA. See more in `https://www.bisa.ac.uk/`

contexts [Roque Hernández et al. 2021], for instance. There is a need for more research in developing countries into this cut.

Equity (DSRQ.3)

About DSRQ.3, the papers approach a wide range of equity issues prevailing gender (13), performance (10, including self-efficacy and expertise), and race (7, including culture and nationality) issues. Few works investigated sense of belonging (2), participation (2), and access (1) issues. In relation to a general equity theory (or framework), no work uses a consolidated theory/framework, usually building its theoretical background from various constructs spread over several references. In this perspective, four works drew my attention concerning their theoretical background, highlighting intercultural computing [Arawjo and Mogos 2021] that resulted from a specification of a previous theory (intercultural learning). Other three works refer to epistemic injustice [Love et al. 2021], gender gap [Bodaker and Rosenberg-Kima 2023], and interest development theory [Michaelis and Weintrop 2022].

This research used the SES to help to choose participants during data collection. However, the thesis's uniqueness resided in using a general equity theory / framework, allowing me to investigate a Brazilian context under well-informed and general equity constructs. A crucial characteristic of my research is using CA as an equity framework. The richness of this choice increases when we consider the singular reality faced by developing countries, deepening the discussion of the deprivation of freedoms and not only about the presence/lack of resources.

Active Approach (DSRQ.4)

At last, in relation to DSRQ.4, most of the papers investigated collaborative learning (25), being pair programming the major part. Few works adopted other approaches like PBL (2), peer-mentoring (2), mixed-approaches (2), and project-based learning (1).

I looked into the SDL as an active approach. The potentiality of my research was focusing on a more general approach (SDL) than a specific one (e.g., andragogy, PBL). Although I investigated a Brazilian context with a PBL scenario, the understanding of SDL is crucial because it dialogues and is part of several other active approaches.

3. Methodology

3.1. Research Context

The research context was an undergraduate IS program in Recife, Brazil. This program is conducted at CIn of the UFPE. In the fourth semester, a PBL approach integrates three courses of this program: MIS, PPM, and BPM. PBL has SDL as a crucial element. NEXT Research Group has a long experience in the adoption of PBL in CEd [Santos et al. 2021], favoring to investigate SDL construct in a structured and solid computing learning space, being responsible for implementing PBL in this IS program.

This research concentrated more efforts on MIS course during the data collection step. My advisor was responsible for facilitating this course in the 2023.1 academic term.

It is essential to highlight that all federal teaching institutions in Brazil adopt affirmative actions for student entry into higher education. These affirmative actions consider

become-a-member/global-south-countries.

various aspects, emphasizing if students attended their whole high school in public teaching institutions. Thus, it should be possible to see significant functioning differences among the students even after four terms of this program.

3.2. Active Learning Context

SDL establishes relations with many active learning approaches. In this section, I present the active learning context in which the SDL construct was investigated in this research. I detail the PBL adopted in this research context, delineating the PBL By-Cycles Framework [Alexandre et al. 2018] from four essential steps in this evolution journey (in order of arising): (i) PBL-Test, (ii) xPBL, (iii) PBL Framework, and (iv) PBL-SEE.

3.3. Methodological Decisions

After the qualifying exam, my advisor and I considered all the contributions from the examining committee and structured the final project to apply for the IRB. Because I collected all data from human subjects in a Brazilian institution, I translated this project into Portuguese before the submission. The IRB manifested their final decision on May 10, 2023, approving this research project, generating the CAAE number 68111823.3.0000.5208.

During the IRB process of appraisal, I conducted part of the document survey. There are several open data sources, like *Portal de Dados Abertos* (UFPE) and *Portal Brasileiro de Dados Abertos*. I obtained aggregated data concerning UFPE IS program, focusing my attention on enrolled undergraduates of the 2023.1 term. The political pedagogical project of the program and the education plans of each course of the integrated PBL class were obtained and are available on the public repository of this Ph.D. study[2].

As part of the consent and assent process, I presented my research project on May 30, 2023, during the first MIS class. This presentation title was "Human Aspects in MIS", lasting 40 minutes. The presentation comprised the following four topics: (i) introduction, (ii) notions on equity and ethics, (iii) research presentation, and (iv) consent for research[3]. In the last topic, I avoided technical terms and concepts, focusing on showing the essence of research and all adopted care concerning research ethics involving humans, including current legal requirements [Bispo Jr. et al. 2021a]. I provided the informed consent form (and all ways to contact me during the research, in case of participation) for each student before this class (both on LMS and repository). I kept the agreement of each student to participate in the research, counting on only those who answered me positively.

For students who voluntarily participated in the research (30 of 35 $\cong$ 85.71% of MIS class), I asked them to fill out a socioeconomic questionnaire. This form allowed me to get socioeconomic information and plot the Lorenz curve from the average HPCI data. This curve helped me to estimate the SES of the class, stratifying them into four classes. Thus, all students belonged to a class alongside a continuum axis ranging between lower and higher SES. The idea was to pick two students and investigate these two ones during the term. I preferred to pick two students from the lowest and highest SES classes,

[2]See `https://github.com/bispojr/phd-info`.

[3]The presentation slides (in Brazilian Portuguese) are available on this Ph.D. public repository: `https://github.com/bispojr/phd-info`.

respectively, aiming to understand if income disparity can be reflected in their capabilities. Another data source came from their classmates and other stakeholders, serving to triangulate and enrich the understanding of the research findings.

The interviews were the most important means of data collection. I conducted three blocks of interviews (in a total of 11 different interviewees). Aiming to preserve the identity of each research participant (RP), I use an alias like RP4 to represent any research participant, and the aliases Chavo and Quico[4] to represent the chosen participants from the lowest and highest SES student groups (Q1 and Q4), respectively. I interviewed Chavo in the first block remotely, and Quico in the second block in-person. Unfortunately, only three women answered the socioeconomic questionnaire, and none of them participated in interviews.

4. Results & Discussion

I structure this section into three parts, matching each RG mentioned previously. Section 4.1 looks to understand Chavo's and Quico's SDL trajectories (RG1). Section 4.3 defines SDL capabilities, mapping its main elements in Chavo's and Quico's SDL trajectories through an analysis of the "taking the initiative" capability (RG2). Finally, Section 4.4 presents a set of equity publications addressing guidelines to (computing) educational stakeholders concerning how to apply this discussion in their concrete context (RG3).

4.1. SDL Trajectories

Aiming to achieve RG1, I develop the discussion about Chavo's and Quico's SDL trajectories from two perspectives: SDL goals (Section 4.1.1) and SSDL stages (Section 4.2).

4.1.1. SDL Goals

Although I presented many possibilities previously concerning SDL contexts (e.g., personal, academic, professional), Chavo's and Quico's main focus was from the skill improvement perspective. There is a central concern related to their professional improvements, potentially aiming for a better position in the labor market.

It is essential to highlight that the underlying Chavo's and Quico's conception can be that which computing refers not primarily to a personal or social transformation. CEd is an opportunity to allow them to dispute in a competitive way among the "players" in the labor market [Bispo Jr. et al. 2024b, p. 428]. It seems that critical reflection appears as a byproduct of this primary pursuit of a good professional positioning.

It is possible that critical reflection is not verbalized due to business culture's tendency to be more "professional" during interview moments. I realize that Chavo assumed this standing during most of the interview, signaling a concern to focus on "professional aspects" of the answers and, consequently, avoiding a more personal tone that could express some elements in this dimension.

[4]Chavo and Quico are characters of Chespirito, a Mexican sitcom written by Roberto Bolaños. Chavo is the main character of Chespirito, a homeless person who sleeps inside a barrel. Quico is the son of Doña Florinda and a late naval captain. Chespirito presents him as a spoiled and overprotected 9-year-old-boy.

In Quico's case, even when the interview followed a more informal tone, his reported SDL case about the development of a Discord bot did not flow to a critical reflection or self-human development *per si*. Quico allowed himself to develop a Discord bot because this effort could promote his skill development.

In both students, the social emancipation dimension was not captured, leading me to believe in a perspective more individualistic concerning this SDL goals. There are no elements to assert that their group participation or the development of their self-direction sought a struggle or fight against some kind of oppressive situation. Two possibilities to understand this phenomenon better are: (i) assuming that we are living in a post-modern condition and, for this reason, there is an absence of an accepted, cohesive, and coherent society structure, leading to individuals not adhering to solid metanarratives or a "cause" that lead them to want to change or reform the society[5], and (ii) realizing the search for meaning (and values) in life can contribute to the existential vacuum including in educational contexts [Şanlı and Ersanli 2021], leading students to give up having a "solid reason" to live truly.

4.2. SSDL Stages

The overall impression is Chavo is situated in the Involved and Self-Directed stages (Stages 3 and 4) from SSDL Grow's axis (Table 1). There is no strangeness for him concerning requirements to the main steps of SDL process. It seems that Chavo handles team activities well and manages these self-study moments reasonably. I felt that Chavo is more independent and appears to assume a considerable level of commitment in his household activities. This behavior seems to facilitate him in a more proactive standing before the demands in a general way.

Table 1. Chavo and Quico situated in the SSDL Grow's axis.

#	Stage	Student	Teacher
Quico	Stage 1	Dependent	Authority Coach
	Stage 2	Interested	Motivator, guide
Chavo	Stage 3	Involved	Facilitator
	Stage 4	Self-directed	Consultant, delegator

In this direction, I want to point out some considerations what I am calling Context-free SDL. We need to think about a set of critical questions about this: (i) Are there cognitive, metacognitive and motivational capabilities able to transpose to learn new skills across the lifespan? [Sheffler et al. 2022]; (ii) Is it possible to think about "meta" SDL competencies (or even capabilities) that can serve as a basis to other more contextualized SDL journeys (similar to the perspective of upper-level ontologies [Niles and Pease 2001])?; What is it possible to transpose as a "meta-learning" from a SDL journey to another one? These questions touch in a central ssertion about a more independent stance of Chavo can be contextualized in new environments like a Management Information Systems (MIS) class using a PBL approach.

Compared to Chavo, I think Quico is situated in the Dependent and Interested stages (Stages 1 and 2) from SSDL Grow's axis. Quico

[5][Bispo Jr. et al. 2022, pp. 278-280] discussed deeper how the perception of identities can affect computing education.

refers during the interview to many situations in which he needed to validate his "right way" of guiding his SDL activities. Quico always validated his choices from third persons (e.g., father, superior) in these cases. I realize this trait is a signal in two directions: (i) firstly, there is more dependency on others, leading to a little developed autonomy (or maybe even a heteronomy); or (ii) secondly, he developed an interpersonal intelligence that leads him to explore more human than non-human resources.

I want to outline some considerations concerning interpersonal intelligence. Depending on how someone usually develops their interpersonal competencies, there are more "suspicions" (or not) related to their self-directedness. If most of someone's interpersonal relationships are inside their family circle, thus this person tends to be considered more dependent and, consequently, less self-directed, being a dependent learner from SSDL perspective. This remembers the three theories of life presented by Tolstoy [Tolstoy 1894, pp. 38,39], ranging from individual, passing by tribe (or clan, family, nation), and, finally, coming to a more general principle of life (that encompasses all created things). From a humanistic viewpoint, when a person transcends an individualistic perspective towards broader levels of belonging, they embody self-directedness in its true essence.

4.3. SDL Capabilities

Perceiving SDL under the lens of competencies is not an innovative approach [Patterson et al. 2002, Morris 2019, Colomer et al. 2021]. In this direction, we can map each stage from Knowles' SDL model as a competency to be developed. However, it is necessary to ensure some minimal elements. Bearing in mind that competency can be defined as the intersection of knowledge, skills, and dispositions (e.g., [Kumar et al. 2023] in CS2023), it expects to deepen each of these dimensions for each competency.

Thus, it is not different concerning capabilities. When we decide to transpose each stage from Knowles' SDL model as a capability, it is also necessary to develop its minimal three dimensions: (i) achieved functionings (or simply achievements), (ii) means (including goods and services), and (iii) conversion factors. We already know that the competencies and capabilities approaches have similarities, but there are many distinctions between these two concepts [Lozano et al. 2012], being necessary that we expand and rebase our way to see competency. Thus, I call them SDL capabilities set, being composed by (i) taking the initiative, with or without the help of others, in (ii) diagnosing their learning needs, (iii) formulating learning goals, (iv) identifying human and material resources for learning, (v) choosing and implementing appropriate learning strategies, and (vi) evaluating learning outcomes. These six capabilities are interrelated and allow us to analyze Chavo and Quico's SDL under the CA lens. I describe one achievement of the "taking the initiative" SDL capability in more detail as follows.

In an educational equity analysis, it is crucial to identify what functionings, beings and doings, are already achieved by students. As the Universal Monarch of [de Saint-Exupéry 1943, p. 74] said, "One must require from each one the duty which each one can perform". All computing educators should consider the current functioning state of their students, seeking to understand what the following steps would be proposed for each one, not only as a learning challenge but also as a fair learning challenge. These achieved functionings are called achievements (A), and I identified a list of them (A1

- Realizing the ”turning point insight”; A2 - Having a minimum volition for; A3 - Being a non-dependent learner; A4 - Dominating a foreign language; and A5 - Possessing computing previous knowledge.) concerning “taking the initiative” SDL capability from Chavo’s and Quico’s interviews mainly.

This is not an exhaustive list (and I am not sure if there is any chance to do it). The aim is to enlighten and expand our vision concerning the reach that an equity analysis can embrace. I discuss one of these achievements (due to space reasons), A1, in more detail as follows.

A1 is “realizing the ‘turning point’”. Let us see what Chavo answered to an interview question unfolding question: “So, I had to use a different method. So... from the scope he gave me, I was researching the points” (underlined by me).

There is a critical momentum, what I am calling turning point insight, that the learner realizes that they need to turn off the receptive (or passive) mode and turn on the active one. This capability to “change the switch” at an appropriate time is directly related to taking the initiative in a SDL journey. This feeling helps the learner to regulate their internal dispositions concerning the problem-solving process, putting themselves in a more active role.

Why a computing educator should pay attention to the turning point insight? Because not all computing students have this achievement when they enter a classroom. These students can be required to get the turning point insight when they pursue their SDL journey. For instance, probably, Quico does not have this achievement in a well-developed way (see Section 4.2). Thus, if this assertion is true, the professors who adopt active approaches must map the development level of the turning point insight achievement in their classroom without leaving anyone behind.

Do I, a IS professor, need the turning point insight as a pre-requirement to develop SDL activities in my class? If I do, I need to diagnose my class concerning this achievement and propose a learning pathway for all students, considering that the “box distribution” usually is not well-configured for my IS students.

4.4. Recommendations

RG3 was addressed by the arrangement of three guidelines and/or recommendations to help educational stakeholders deepen this discussion in their context. I will present each one in the next three following sections.

4.4.1. Non-Neutrality

First, other colleagues and I structured the discussion about neutrality in CEd [Bispo Jr. et al. 2022] from the Brazilian context, bearing in mind that it is not possible to take further steps toward equity awareness without giving up the neutrality presupposition and assuming a minimal set of democratic commitments, intentionalizing their teaching practice. This essay threw light (and some provocations) on the discussion about the supposed political-pedagogic neutrality of professors and its impacts on CEd. It presented a little of the Brazilian context concerning the theme of political-pedagogic neutrality and its problematizations. It also exposed some struggles to understand the potential implicit

agenda of supposedly neutral discourses and the importance of admitting intentionality in professor practice in CEd. This essay still proposed a possible way to build professor identity/ies from a moderate pluralism. We made use of some authors to contribute to the deep of this discussion, like [Freire 1996], [Skovsmose 2006], [Saviani 1994], [Hall 1992], and [Biesta 2018].

4.4.2. LLM Equity Issues

Second, my advisors and I situated emerged equity issues from the use of large language models(LLM) in (computing) education [Bispo Jr. et al. 2024b], emphasizing what we called "Prompt Literacy" and the arising of LLM divide due to the handling of metacognitive competencies. In the second section, we presented the digital divide, listing more common barriers to ICT use, the potential mitigation actions for the digital divide problem, and elements to signalize the subjacent structural problem as its roots. In the third section, we described LLM, presenting practical examples, as well as showing the opportunities and challenges of its use in educational contexts. In the fourth section, we described the arising of what we call "Prompt Literacy" redeeming the evident evolution (in terms of the complexity and impact of ICT) from Web Access Literacy, passing by Search Engine Literacy, and arriving in Prompt Literacy. Lastly, we defined LLM divide as the gap between those with ready access to LLM tools (and the knowledge that they provide access to), and those without such access or skills. We also defined what would be an LLM capability under the CA lens, listing the primary sources of LLM equity issues from this perspective.

4.4.3. Equity Analysis Guidelines

At last, in another work of my advisors and I, we proposed not only a basic discussion about the equity aspects of the adoption of Online Laboratories in Engineering Education (OLEE) [Bispo Jr. et al. 2024a], but also we listed a set of guiding questions to north an initial equity analysis for collective decision-making in a professor collegiate. Using a storytelling approach, we presented an Engineering Professor called Jirafales[6] in his journey to adopt OLEE in his engineering program. Hypothetical situations (but potentially real) illustrated several equity issues that usually emerges in our teaching practice concerning access, literacy, and social factors. For each of these dimensions, we introduced theoretical constructs about equity from CA lens. The idea is to pave the way for an identification with equity agenda, offering the opportunity for a professor watches themselves as part of Jirafales' dilemmas, feeling his feelings and trying to sketch a practical solution for each fictitious scenario. Empathy and theory walking together: helping each other to forge a new awareness in Engineering Education community. Finally, we created a roadmap comprising of strategic steps (one for each dimension) to follow when a collective educational space needs to conduct an equity analysis.

[6]Teacher Jirafales is one of the characters of Chespirito, a Mexican sitcom written by Roberto Bolaños.

5. Final Remarks

This work investigated how CEd students conduct their SDL in developing countries from the CA lens (MRQ). Three research goals (RG) helped to address this question in a qualitative approach: (i) understanding how CEd students build their SDL trajectories in developing countries (RG1), (ii) mapping the main elements of SDL capabilities observed in CEd students in developing countries (RG2), and (iii) recommending guidelines to (computing) educational stakeholders concerning how to effectively consider equity issues and active learning from the CA lens (RG3).

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