Lack of Diversity: Are you part of the problem or its solution?

Mirella M. Moro
mirella@dcc.ufmg.br
Universidade Federal de Minas Gerais - UFMG,Brazil

ABSTRACT

Do Computing courses properly prepare students for dealing with diversity, equity and inclusion? This essay delves into such a question by presenting a survey taken by Computing educators, and discussing issues, solutions and challenges within different Computing areas. It is also a call to action, because when dealing with such matters, there is no being on the fence: a person is either part of the problem or working towards its solution.

CCS CONCEPTS

• **Social and professional topics** → Computing education.

PALAVRAS-CHAVE

Diversity, Equity, Inclusion, Computing Higher Education

1 INTRODUCTION

An academic urban legend states that *Universities*[1] *do not prepare for the industry*. Many people in Academia have heard it, students, educators and staff. It usually comes with one example (or many) on: how people without a higher education degree are successful, how the IT (Information Technology) industry has good paying jobs for people from other areas independent from formal degrees, how universities do not keep up with the industry fast evolving pace, how a friend with a degree in Engineering is an app driver now, and others. Educators tend to answer such claims with a simple fact: it is not our university objective only to prepare you (the students) for the industry; followed by reasons on how the university has a deeper impact on the lives of people who take it seriously, and provide solid knowledge and skills to develop the future of such industry, and perhaps, make a true impact in our lives.

In such a context, the focus of this essay is also a critic in nature, but on a deeper level: do Computing[2] higher education courses prepare students for a *fast pace evolving society*? Specially, do Computing courses properly prepare students for dealing with diversity, equity, inclusion (or DEI), bias, minorities, and privilege awareness? Which goes to the title of this paper: when dealing with such matters, there is no middle ground, no being on the fence, because either a person is part of the problem or such a person is working towards its solution. Note that acknowledging the problem existence or trying to understanding it also qualify as working towards a solution. The question then becomes: where do you stand?

1.1 Motivation

As technology evolves, so does society (and vice-versa); which in turn requires updates on teaching methodologies and undergraduate curricula. For example, take the last years of the 20th century. At that time, students used to read books in the University library and enjoy its facilities for individual and group studies. Specially around 1990, Internet cable connection was a *privilege* limited to universities and research centers; whereas dial-up connection was the only option for few Brazilian homes and businesses whose owners could afford it. Moreover, the usage of the Web was similarly limited to email, Yahoo directory search, few online games (with simple interaction and interface) and chat rooms. Still, studying Computer Science (CS) was not boring at all. For example, in my undergrad, the Artificial Intelligence (AI) class had a checkers game project. Its interface was very limited, but the whole project was exciting, and done solely relying on three sources of knowledge: the class educator and textbook plus the aforementioned library.

Back then, most researchers seemed to be rethinking everything from the perspective of the Web: the Web architecture, databases connected through the Web, entire systems distributed over the Web, Web and Society, Web interface, Web data structures and indexing, HTML and Web coding languages, and so on. Amid such revolution, few were digging on the inevitable: Education on the Web, Web-based Education, Education for the Web, and all sorts of mixtures between the traditional Education style and whatever the Web could or should provide. And guess what? Twenty-plus years later, we are still looking for the mix right formula.

Such mix includes students and educators. Considering the checkers game project today; are the students *still* working on a limited interface or are they aware of its users' *diversity*? Does it allow customization according to the gamer's age, for example? Does it allow to change color, adjust contrast and font size for people with visual disabilities? Does it have an audio setup that narrates each play and accepts voice commands? Does it work on a four year old cell phone? Does it provide tips and walking-through? Does it follow gender inclusivity principles? It should [18, 47].

In summary, as technology and society evolve, so do solutions and problems on Computing and its Education. Now, although this essay is on such a large context, it is not about the technology per se. It is about discussing how Computing educators deal (or not) with diversity (plus equity and inclusion) in their classes, as exemplified by the checkers game scenario. Students should answer *yes* to the questions posted in such example, after proper information provided in class or by class materials.

[1] Although Brazil has different types of higher education institutions such as Colleges and Technological Education Centers/Institutes, in this essay, they are referred to as *universities* for simplicity only.

[2] Henceforth, *Computing* courses stand for all types of higher education courses towards Computing, including but not limited to: Computer Science, Computer Engineering, Information Systems, Information Technology, Software Engineering, Teaching in Computing, Computing Systems, Technical Majors, and so on.

EduComp'22, Abril 24-29, 2022, Feira de Santana, Bahia, Brasil (On-line)

1.2 Contributions

Overall, society evolves and so do our students, and so should we – professors, lecturers, instructors; but do we? Or is such evolution limited to the technical contents and teaching methodologies of our classes? Specially, as society becomes more diversity aware (including IT market and industry), are our Computing courses keeping up with such evolution? Those are complex questions that require way more than one single essay to answer.[3] Hence, this paper focuses on DEI and delves into the following contributions.

- A summary of different concepts and related work on DEI, with special focus on Computing Education (Section 2);
- An initial survey and results about DEI within Computing higher education (Section 3);
- A discussion on issues raised by the survey, their challenges and solutions (Section 4); and
- A call to action so that everybody in Computing Education gets excited about being part of the solution (Section 5).

2 CURRENT STATE OF AFFAIRS

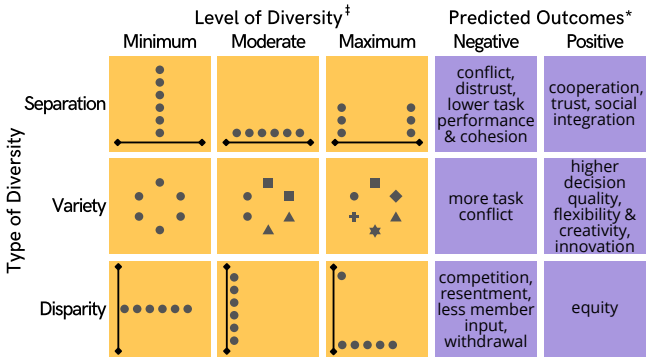
Before diving into the literature, this section starts with simple statements that set the tone for the whole text. *Diversity* is frequently associated with gender diversity, but the concept itself applies to other types (e.g., race and age). Diversity is also more than just hiring people from different backgrounds. For instance, hiring a couple of women does not turn a male dominant company into a diverse one. Although it is currently a buzzword, diversity issues have been around for decades now, being often associated with *equity* and *inclusion*. However, fostering inclusion is more than just hiring a person with physical impairments, or placing a black person to work within a white-only team. Likewise, equity involves more than equal pay for a white man and a black woman who have the same job description and responsibilities. It is true that the American-born movements `#metoo` and `#blacklivesmatter` made gender diversity and race inclusion get the spotlight beyond the movie scene and the suburban American lives and police innate prejudice. Nonetheless, once again, although such movements are deeply appreciated for their impact and power of change, diversity, inclusion and equity go way beyond the aforementioned cases.

Research on DEI is vast and tackled from distinct angles including anthropology, business, civil rights, economics, education, psychology, and social sciences. As it is impossible to cover everything in a couple of pages, this section follows with concepts and a *representative set* of related work on diversity, equity and inclusion. Then, it goes over current scenarios on IT industry and market, and research on such topics within Computing Education. It ends by emphasizing this essay contributions over such rich context.

2.1 Diversity

The intuitive definition for *diversity* is having a group of different people together, which is clearly not enough because it begs the question: define "different". Within basic education, UNESCO [53] defines diversity as the people's differences regarding one feature,

[3]Indeed, complete answers to such issues go way beyond what Computing educators alone may accomplish, as solutions also require norms and curricula flexibility, and society support, for example. Still, the focus here is on how we prepare our students for working within/for/with increasingly diversity aware industry and society.



‡ This part of the image is an adaptation based on [19]. Whereas the original authors call the columns as "Amount of Diversity", here they are called "Levels", as they are not always exactly quantifiable depending on the attribute (e.g., quantifying pay and knowledge versus quantifying belief).
* Sample list of outcomes in general, considering the most common attributes such as gender, pay, background, beliefs, among others.

Figure 1: Simplified graphical representation of the three diversity types and their levels, based on the meanings of within-unit diversity, with respective predicted negative and positive outcomes.

including gender, race, mental and physical ability (see ANNEX). A better model for *diversity* is given by Harrison and Klein [19], who argue that its definition is attribute-specific and applicable to a group, or unit; i.e., a group is diverse regarding one (or more) attribute(s) of its members. Then, the concept of *diversity* is actually composed of three *different* perspectives: *separation*, as differences in position or opinion among group members; *variety*, as differences in category (information, knowledge, or experience) among groups members; and *disparity*, as differences in concentration of valued social assets or resources. Depending on the context, demographics features (e.g., gender and race) may fit in any of such perspectives. With thousands of works building upon (or citing) Harrison and Klein's three-component diversity definition, the next paragraphs summarize its main points that are better connected to the reasoning used in this essay.

Figure 1 presents the three types of diversity on three levels: at the minimum level, all three types configure a homogeneous, similar group regarding one (or more) attribute(s), e.g., a group whose members agree in one belief has minimum separation, and whose members get the same salary and benefits, minimum disparity; at the moderate one, there is a uniform distribution regarding such attribute(s), e.g., a group with moderate disparity has one member at each pay grade; at the maximum perspective, each type has a unique situation. A group with *maximum separation* in one attribute is a bimodel; i.e., the group is half split and its members polarized on two extreme, opposing factions [20] (Fig. 1 first line, third column). At *maximum variety*, the group is more interesting and has richest possible distribution of information, with each member coming from a unique category of an attribute (Fig. 1 second line, third column). *Maximum disparity* (also called inequality) requires one member of the group getting the highest value or being at the top for one attribute, and all the others getting its minimum or being at its bottom (Fig. 1 third line, third column).

Each type of diversity has optimal scenarios (for specific attributes) that provide positive outcomes. Such scenarios are not always at minimum or maximum values. Likewise, unbalanced situations may generate conflict and negative outcomes. A summary of such outcomes is in Figure 1, the two right-most columns. All outcomes depend not only on the lack/presence of diversity type but also on the personal skills and culture of the people within a group (i.e., having the best scenarios for all three types of diversity within a group will not avoid conflict if one of its members is difficult, for example). Still, with guidance, empathy, proper mindset and leadership, it is possible to get the best of each diversity perspective.

2.2 Equity and Inclusion

As aforementioned, *equity* is more than providing equal pay to equal jobs, and *inclusion* is not just adding ramps throughout campus for people with mobile disabilities. A peculiar study was published based on gender equity in one of the most important technology institutes (the MIT) by Lotte Bailyn [3]. She goes deeper into defining *gender equity in academia*. The initial definition is "equal pay, equal access to opportunities to enter an occupation and to advance in it, and freedom from harassment." Although a relevant definition, Lotte Bailyn successfully argues that equality is not equity: "Equity will not be possible if there exists one group of people (for example, people with care responsibilities) who are systematically unable to meet the requirements of the ideal academic who gives full priority and all his time and energy to his academic work." In other words, an equitable workplace shall only exist on equal opportunities and *equal constraints* – which due to cultural and historical reasons are not the same for women and men (in the USA and in Brazil).

Inclusion has also appeared in various studies and is often associated with K-12 education (or *inclusive education*) of kids with disabilities. In such a context, the major debate is to provide highly specialized education to such children in a separate environment, versus to provide a truly inclusive education in which all children (regardless of diverse needs) share the opportunity of learning together [29]. Making the concept broader to beyond education, Kelly Gaither [14] defines inclusion as follows.

> [Inclusion] reflects the quality of a group or person's experiences, referring to an individual's state of being valued, respected, and supported. Thus, diversity and inclusion must be coupled. [...] Diversity is a direct reflection of recruiting from a broad talent pool. Successfully keeping and retaining diverse talent is a direct reflection of inclusion.

2.3 Within IT Industry and Market

Many companies from different sectors have turned their attention and resources to advancing one or all three DEI – e.g., SAP,[4] OPG,[5] and Google.[6] Being (measurable) result-oriented, such companies still struggle to assess the impact of their actions and clear communicate such impact to stakeholders. To do so, there are two basic solutions: relying on scientific approaches (e.g., existing metrics [19]) or proposing new ones (e.g., a new inclusion index by [43]). Also, ranking companies according to DEI is possible through statistics such as percentage of minorities on the board, percentage of employees who are women, with disabilities, and so on.[7]

The IT Industry and Market are no strangers to diversity and its importance. Indeed, many studies have discussed, showed and surveyed its facets, advantages and issues. For example, Hewllet, Marshall and Sherbin [23] are among the first to claim that "diversity unlocks innovation and drives market growth," which is associated to compelling evidence. Different from the three-type model, diversity is divided into two types: *inherent* as traits a person is born with (e.g., gender and ethnicity); and *acquired* as traits a person gains from experience (e.g., living abroad provides cultural awareness, and selling to female consumers provides gender smarts). Then, companies whose leaders express at least three inherent and three acquired diversity attributes surpass others (without such leaders) in innovation and performance. For inherent diversity, when at least one member of a team shares a client's ethnicity, that team is better equipped to understand such a client. Also, leaders should work on their (and their teams) acquired diversity to unlock innovation, by focusing specially on six behaviors: ensuring that each team member is heard, welcoming novel ideas, giving team members decision-making authority, sharing credit for success, plus giving and implementing feedback to/from the team.

As diversity is a complex subject, business or industry-oriented publications focus in one issue at a time. For example, Brazil and USA have lived in a political polarity scenario (i.e., maximum *separation* diversity) for a couple of years (due to reasons beyond the scope here). Despite those countries differences, the symptoms and collateral effects have much in common. Reeves et al. [40] tackle the political polarization by presenting 12 strategies to company leaders amend their polarized fences, which include: foster healthy engagement, ensure respectful interactions, and catalyze inclusive communities. Although simple in text, most strategies require not only advanced soft skills but also DEI-aware and -oriented mindset.

Regarding equity and inclusion, publications also describe problems and aim at solutions, one issue at a time. For example, there are studies on COVID-19 pandemics and gender equity [26]; and an interesting, direct approach with a road-map on issues of willing to change on racial equity [31]. On the other hand, the adjective *inclusive* also qualifies any environment, initiative, action or even leadership that works towards solving, improving or advancing diversity issues. Such initiatives may be tailored for one kind (or category) of diversity, such as social-economic inclusion [13]. There are also studies in IT companies on minorities and how they perceive their work environment; i.e., if theory of an inclusive work space is actually practiced (e.g., gender and sexual orientation) [45].

2.4 Within Computing Education

Computing Education research has also focused on equity, one issue at a time. For example, there are initial studies on the performance of boys and girls in primary and secondary education regarding information and communication technology [54]. Other studies dive into the reasons for lack of diversity in Computing at college

[4] https://blogs.sap.com/2020/11/24/fostering-an-inclusive-culture-is-a-business-imperative-not-a-trend
[5] https://www.opg.com/innovating-for-tomorrow/commitment-to-diversity
[6] https://diversity.google
[7] https://fortune.com/2021/06/02/fortune-500-companies-diversity-inclusion-numbers-refinitiv-measure-up

level, which include students' sense of belonging in computing as an important predictor of student retention [30]; and differences in local interactions and social positions (e.g., opportunities to ask questions in class, and work on real-world problems) as contributing to sense of belonging in computer science [4].

Still in Computing education, there are reports on actions to attract more girls and girls of color to Computer Higher education [17] and grad school [44]. Such initiatives are creative and rely on skills that girls may connect to technology, e.g., knitting and sewing [8]. Likewise, in Brazil, there are studies assessing gender diversity and reporting initiatives to attract and maintain women in Computing, e.g., [32, 34, 41, 42].[8] Going further, since 2015, IEEE Special Technical Community on Broadening Participation[9] organizes the RESPECT conference - *Research on Equity and Sustained Participation in Engineering, Computing, and Technology*, which has published many research, project and initiative results towards DEI.

Official curricula documents also consider DEI at some level. Specifically, ACM/IEEE's Computing Curricula 2020 [12] has a section dedicated to Project Diversity (Section 1.1.3) that includes "the need for accessibility for all people", "the importance of diversity", and a recommendation for promoting "best practices to attract and retain greater student diversity." Nonetheless, it explicitly informs that *how* to achieve them is not discussed in the report. Diversity also appears in other sections: 2.4.5: Computing in Primary and Secondary Education, 3.2.5: Global and Other Considerations, 6.5.3: Cultural Sensitivity and Diversity (this one also discusses inclusion of people with disabilities), and I.3: Factors Affecting Agile Computing and Engineering Education. Then, ACM's Cybersecurity Curricula [37] lists "Ethics and equity/diversity" as topics within the Cyber Ethics knowlege unit, a part of the Societal Security Knowledge Area. Still by ACM, the Data Science document [11] has a whole chapter to "Broadening Participation" (Chapter 5), which informs "intentional inclusion and diversity are necessary to reduce societal bias as data science continues to be used for decision making from health care to hiring decisions." It also cites the CNDLS Inclusive Pedagogy,[10] which informs "Inclusive pedagogy at its core is learner-centered and equity-focused" making it (currently) the most DEI-oriented document.

In Brazil, the official document from the Brazilian Computer Society (SBC) on post-secondary education [60] does not mention equity nor inclusion, but mentions diversity. Specially, the following parts are of interest: the benefits of *Computer Science* professionals to society (Chapter 2, Section II.3) refer to the ACM/IEEE CS Curricula 2013 when defining "to value diversity" as one mandatory personal trait of CS Graduates; a legal requirement for *Teaching in Computing* professionals (Chapter 5, Section V.9) quotes a resolution from the National Education Council, which includes "courses shall guarantee specific contents [...] as well as contents related to [...] ethnic-racial, gender, sexual, religious, and generational diversities"; and the Systemic Vision axis of *Information Systems* (Chapter 6, Section VI.6) includes "digital inclusion". The respective Graduate document [2] has no mention at all to DEI.

[8]Mostly published at the Women in Information Technology workshop, the largest academic event in Computing on gender diversity, held yearly within the Congress of the Brazilian Computer Society. Anais do WIT: https://sol.sbc.org.br/index.php/wit.
[9]IEEE STC on Broadening Participation: http://stcbp.org
[10]CNDLS: Inclusive Pedagogy: https://cndls.georgetown.edu/inclusive-pedagogy

Finally, as most institutions do not include such topics in their Computing higher education curricula, most companies rely on internal training [5, 24]. To be fair, it seems that DEI is still out of most technical curricula. Yet, note that, even if Universities should not prepare students to deal with the current buzzword, DEI has started as a trend but has also established itself as a social, economic, cultural and even humanitarian necessity.

2.5 Contributions over Related Work

This essay builds upon existing literature by surveying the coverage of DEI topics in Brazilian Computing higher education. Then, based on the survey results, it also raises issues and challenges that shall serve to foster solutions throughout the Computing Education community. To inspire such solutions, it ends with calls for action.

3 AN INITIAL SURVEY

One key contribution of this essay is to make educators think about DEI. Now, whatever reasoning presented here may be in jeopardy if not properly backed up by existing literature, survey or common knowledge. There is also a chance of some people reading it be already working towards improving DEI; and then having doubts on the need for further thinking and taking action.

In the absence of such a survey in Brazil, this section presents one to get an **initial overview** about Computing Education regarding DEI. It is grounded on the following hypotheses:

> **H1** Brazilian Computing educators do not cover (or open space to dialogue about) Diversity.
> **H2** Covering DEI depends on the discipline subject.
> **H3** There are opportunities to improve.

The survey setup is summarized in Section 3.1, followed by basic statistics in Section 3.2 and results in Section 3.3.

3.1 Setup

The survey form was published in October 2021 and sent out through email and social media. It contains questions about DEI in Computing Education at all levels. It is *not* the goal of this essay to present the *whole* survey, but rather to focus on the questions regarding the aforementioned hypotheses. Hence, statistics and results are those provided by people who teach in Computing undergraduate and graduate courses. The questions covered here are separated in two parts, as follows.

- Basis statistics – Brazilian state where the respondent works; type of institution (public, private); and whether respondent belongs to a minority.
- Specific information – the respondent addresses (or opens space to) DEI during class (**H1**); if so, type of diversity covered or willing to cover (**H1**); otherwise, reasons not to address DEI (**H3**); and Computing areas taught (**H2**).

3.2 Basic Statistics

The survey was answered by 118 people from 20 Brazilian states (including the Federal District) who teach in Higher Education (including four who only teach at grad school, and 11 who also teach in high school). Regarding regional distribution, 60 educators

Table 1: Number of respondents and percentage divided by area (name used in the paper and example of content)

# -	% -	Area Name	Content Example
66	55.9	Technology	Computer/IT Technologies: Databases, Comp. Networks, AI, Software Engineering, HCI, Comp. Graphics, Circuits, or similar
31	26.3	Introduction	Introduction to programming, computing or information technology, software, hardware, tools, applications; and others
24	20.3	Intermediate Progr.	Intermediate and advanced programming; data structures; programming languages, techniques and paradigms; and others
24	20.3	Foundation	Comp. fundamentals including: architecture and organization; systems; parallel processing; security; compilers; and others
17	14.4	Society, Ethics	Comp. and society; ethics; digital inclusion; legislation; entrepreneurship; copyright; privacy, civil rights; and others
14	11.9	Theory	Theory of comp., graphs, logic, formal methods, algorithm complexity, discrete math, formal languages, and others
12	10.2	Management	Project, people, time and career management; management and planning; professional, scientific communication; marketing; and others
12	10.2	Comp. Thinking	Computational thinking, problem solving, robotics for children/youth
4	3.4	Other areas	Mathematics, physics, probability, statistics, administration, engineering, electronics, teaching, pedagogy, education, economics, English, Portuguese, philosophy, and the likes

come from the Brazilian Southeast, then 26 - South, 16 - Northeast, 9 - North, and 7 - Middle west. Most teach in public universities/colleges (106) and few in private institutions (12). Regarding minorities, as self-declared in the survey form: 68 do not think they belong to any minority group, 29 belong to one minority group, 17 belong to more than one, and four preferred not to inform. Finally, Table 1 presents the number and percentage of respondents divided by Computing Area,[11] which is listed as an abbreviation (used in the remaining of this text) and example of content. Note that such content was grouped into nine categories to easily enable potential insights. Such categories could be further grouped into: computing basics (comp. thinking, introduction, foundation), computing (intermediate progr., technology, theory), social aspects (society, ethics; management), and other areas (math, physics and so on). In other words, there are different ways to group Computing knowledge areas, including by ACM and SBC standards. Nonetheless, such divisions would probably not add much to the insights and would rather make the survey form more complex than needed.

3.3 Results

This section presents and discusses results divided by hypothesis.

H1 - Brazilian Computing educators do not cover (or open space to dialogue about) DEI. The first important question in this survey form is: *Do you address or open space to address issues of diversity, equity and inclusion in your classes?* Now, one would expect that most people interested in answering the survey would be *exactly* those that *do* know the importance of DEI-awareness or concepts and, therefore, cover them in class. This is an expected bias in this kind of voluntary survey. However, with 118 respondents, 59 answered **YES**, and 59 answered **NO**; i.e., half of respondents does address DEI in their classes, and half does not. Then, the survey goes one step forward to verify which types of diversity are covered or are in the wish list to be covered.

Considering only people who **cover** DEI in their classes, Figure 2 shows their answers to two questions: (1) *Select which type/s of diversity you address in your classes*; and (2) *Select which type/s of diversity you would *like* to address in your classes*. The top two are

[11] Each respondent should select one or two areas.

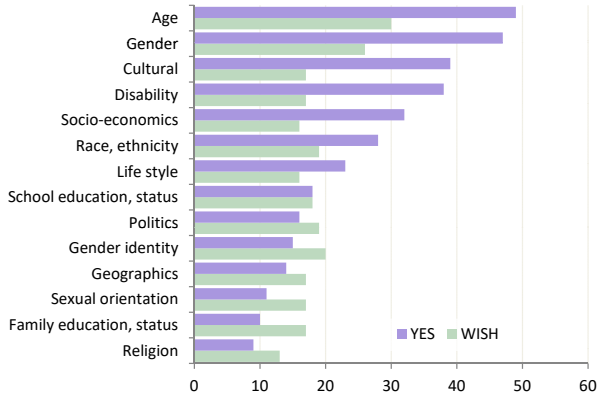


Figure 2: Select which type/s of diversity you address in your classes (*YES*). Select which type/s of diversity you would *like* to address in your classes (*WISH*).

the same for both questions: *age* and *gender*; which are followed by *cultural* and *disability* in the addressed diversities, and *gender identity*, and *race/ethnicity* tied with *politics* in the wish list.

Overall, hypothesis **H1 is partially confirmed**, as half of respondents covers some DEI concepts, with focus on few types of diversity. Furthermore, *Race and ethnicity* ranks in 6^{th} place of covered types, and 4^{th} place of the wishing list. Such a result may reflect a white-culture dominance in the area that could be on the verge of changing (giving the number of people wishing to cover such diversity as well). These results need further study, as the survey needs a larger set of answers to be truly representative; still, it provides an **overview** of the current situation.

H2 - Covering DEI depends on the discipline subject. Figure 3 shows the result for the previous question separated by area (see Table 1 for names used). In other words, from the people who marked Computational Thinking as their teaching content, 83.3% address DEI issues in such disciplines. As expected, the top of this figure contains the more *social*-oriented classes of a Computing curricula, i.e., Computational Thinking; Society and Ethics; and Management. This result is expected due to the more society-oriented, current-issue nature of such disciplines. At the bottom, the figure shows Technology at 42.4%; Theory at 35.7%; and Intermediate Programming at 29.2%. Classes on Theory areas are more theoretical (obviously), being probably trickier to locate examples and exercises into current social issues. Nonetheless, Technology and Intermediate Programming are probably a surprising result. Teaching intermediate and advanced programming, data structures, databases, computer networks, and other contents requires many examples, which could easily cover current issues such as DEI.

Furthermore, Technology includes Software Engineering, which is also responsible for industry-oriented content such as software design and life-cycle (including software test). Likewise, it contains HCI (Human-Computer Interaction), which is very close to society, as users are part of it; and Computer Networks, whose access in Brazilian territory is pretty varied. It is hard to imagine such contents being explored without considering people with disability, different literacy levels and life styles, for example.

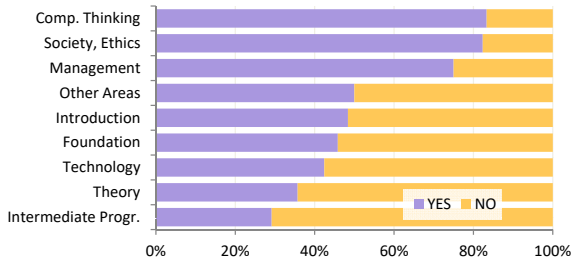


Figure 3: Do you address or open space to address DEI in your classes? Percentage of answers separated by teaching area.

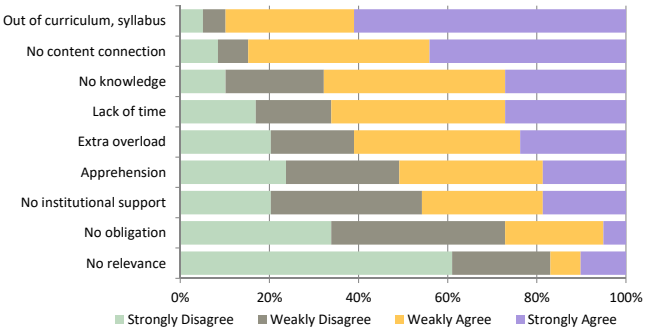


Figure 4: You do not address (or open space for) diversity issues in your classes; analyze why.

Overall, hypothesis **H2 is confirmed**, with more social-oriented disciplines mostly covering DEI-aspects, more theoretical ones covering less, and some surprising cases regarding Technology and Intermediate Programming, which also cover less DEI.

H3 - There are opportunities to improve. The last set of questions verifies reasons for not covering any diversity during class. Figure 2 shows the types of diversity that are more/less covered in classes. The first opportunity for improvement is covering more types, as well indicated by the wish list – in the same figure.

Now, half of the respondents does not cover any issue related to DEI concepts. Hence, this is practically the biggest opportunity for changing the scenario. Nonetheless, any change requires assessing the current status; hence, Figure 4 qualifies the reasons for them not covering DEI and allows the following conclusions.

(1) Most people *disagree* with not being obliged to cover DEI and DEI not being relevant – i.e., such people are potentially susceptible to change towards addressing DEI in class;
(2) Exactly half feels apprehensive (fear) about creating problems, offending someone, getting disapproving feedback and others – such feeling is justified, specially in regions or institutions that are close-minded regarding diversity; also, there could be some relation between this set and the one selecting "No knowledge" as well, because without knowledge, the fear of offending someone is certainly higher;
(3) Lack of time and extra overload also appear as strong reasons to not cover DEI – such reasons are completely understandable specially during the COVID-19 pandemics, when everybody is facing adversities beyond imagination; and
(4) The top two reasons are "Out of curriculum, syllabus" and "No content connection", which are definitely related to each other – and here is a great opportunity for change.

Overall, each survey result offers reasons to make Computing Education evolve towards DEI; specially considering the types of diversity covered, those in the wish list and the reasons why people do not cover them. Taking all three pieces of information together points to one result only: **H3 is confirmed**, and there are many opportunities to improve. Note that, although this paper is an essay (or position paper), the initial survey was essential to support any position taken when defining issues, proposing solutions and establishing challenges, as discussed in the next section.

4 ISSUES, SOLUTIONS AND CHALLENGES

Based on the initial survey (Section 3), the main reasons for not covering DEI issues in Computing classes may be separated in two groups: (1) *academic*, i.e., DEI being out of curriculum/syllabus and having no connection to the class content; and (2) *personal*, i.e., the person having no knowledge and time, and wanting to avoid the extra overload of covering such content. Hence, this section follows by better organizing those issues and presenting their initial solution directions, which have challenges. Each challenge is then stated and discussed, followed by one or more specific solutions.

4.1 Academic Perspective

4.1.1 Issue: DEI is out of curriculum/syllabus. Once again, society has evolved and so should our teaching manners and content. Computing is probably the fastest evolving area within any higher education institution. It should *not* have its content *strongly* tied to a curriculum that lasts years and takes years to change as well. Also, official curricula documents (by societies such as ACM and SBC) do mention diversity (inclusion and equity to some extent) as important or valuable, as part of professional profile or a legal requirement, or within ethics content. Such curricula also allow tailoring according to the institutional and regional culture, needs, student profile, and so on. UNESCO is also on board of a more DEI-oriented curriculum (in any area and education level), as informed in [53]: "The curriculum is the central means for enacting the principles of inclusion and equity within an education system." Then, educators are eager to include cutting edge technology to their discipline syllabus (e.g., blockchain and quantum computing), even way before such topics appear in any official curriculum; but, they do not include DEI because the curriculum does not explicitly mention it – is it a conundrum, hypocrisy or lack of empathy? Putting all together, it is safe to claim that: *DEI does not need to be explicitly informed as body of knowledge or content tied to a discipline in order to be part of any curriculum or discipline syllabus.*

4.1.2 Issue: DEI has no connection to the class content. This issue seems connected to the previous one, as curriculum and syllabus define the content of a discipline, which is divided into classes; still, it is at a finer granularity by focusing on each class. DEI refer to distinct aspects of society by poiting out problems due to their lack and a potential utopia scenario when they are fully operating

in harmony. Now, one core argument here is society evolving requires how/what we teach in Computing to evolve too. Diversity, equity and inclusion are relatively old concepts, but how much society minds them – with worldwide campaigns, companies hiring policy updates and minority-oriented training initiatives, inclusion-oriented marketing, movies and TV series – is new. Indeed, in a recent panel during the largest international event on CS Education [22], a panelist from industry stated: "Academia is responsible for recognizing and developing a supportive environment for new computing talent. Biases reflected in academia today will spread to other areas that computing touches, including any and all technical advancements and future generations of technologists." He is right, as trying to connect a class concepts do DEI, or making them more DEI-aware, is responsibility of its faculty. As any Computing class should prepare students for a professional life in Computing, within a society, with many ethical responsibilities, with social skills that range from being able to communicate problems/solutions to being aware of differences and having empathy to other persons struggles, the conclusion is somehow obvious: *adding DEI content to class means preparing better, wholesome professionals, in any area but specially in Computing* – which is more technical-oriented than human/society-oriented, by definition, and has the power to affect any other industry, market and commerce field as well.

4.1.3 Academic Solutions and Challenges. Both academic issues point to one solution: DEI should be part of Computing education; a simple solution, but not free of challenges, as discussed next.

Challenge A: Who should teach what or to which extent? Some colleagues may point out this is not a challenge, as the answer is obvious: Computing curriculum has an Ethics discipline that should cover any(all) aspect(s) related to DEI. Then, change *Ethics* with "Computing Ethics", "Professional Ethics", "Computers & Society", "Computing Social Aspects", "Technology, Ethics & Society", or any other combination, and this answer is probably valid for most institutions that offer a Computing major. The question then becomes: is it enough to cover such a complex topic (DEI) within some classes during a 60h discipline? No, it is not enough. However good its instructor is, it is probably impossible to cover all DEI aspects that are relevant to a Computing professional within a sole discipline of a vast curriculum. A better answer to such a challenge is then: *DEI should be a discussion aspect of any discipline within a Computing major*. How? See some practical ideas ahead.

Solution 1: Include DEI within any class. There are many ways to do so, as the following ideas (* from Brazilian groups).

- Ali et al. [1] go over a famous optimization scandal regarding bias, the Facebook ad discrimination case, which may certainly be discussed throughout different disciplines;
- M. Burnetts' team [18] go over current practices and pitfalls when considering gender inclusivity as a Software Engineering (SE) quality requirement – her *GenderMag* method (for detecting and fixing gender inclusivity issues in software) could be discussed in many SE disciplines;
- Cunha* et al. [9] discuss how to enhance intercultural awareness and communication in highly diverse environments from the requirements definition perspective;
- Gonçalves* et al. [16] focus on designing for the elderly, including issues on mobile software and hardware interfaces;
- Kirkpatrick [27] discusses bias issues of algorithms, data, and AI in a short article smartly titled "Algorithmic Poverty", which provides insights to be discussed in many classes;
- Krakovsky [28] explains bits of history on the building of Gaudi's Sagrada Familia that could be explored in geometry and systems modeling classes, being easily connected to (probably) the most sensitive kind of diversity, religion;
- Neris* et al. [36] present how to cover diversity and inclusion in the perspective of system design, aiming at digital and social inclusion;
- Srinivasan and Chander [46] summarize the main types of bias within AI systems, which could be covered not only in AI classes but also databases and software testing;
- Stumpf et al [47] brilliantly review the state of the art in gender inclusive HCI, with over two hundred studies that could be covered at undergrad or grad level classes;
- Thinyane [48] focuses on a specific diversity group (migrants) and includes such a group in the design of an app for migrant workers to report exploitative practices; and
- Walther and Ladner [55] discuss accessibility (i.e., inclusion of people with disabilities) by connecting it to Web design/development, software engineering, human-computer interaction, operating systems, and any course that addresses human-facing hardware and software, then giving tips and further readings – they also emphasize "Accessibility needs to be taught throughout the computing curriculum."

The next solutions present further ideas in this context.

Solution 2: Include DEI within your classes. Even with such examples, some colleagues may still think none of those applies to the content they teach. Fair enough. Then, invest some minutes reflecting on these questions regarding *any topic you teach*, they may give the insights needed to start adding DEI into your classes.

- How may it impact diversity/ equity/ inclusion?
- How could it be explored for improving diversity/ equity/ inclusion issues? or for overall social good?
- Is there any way it could be explored for intensifying privilege, oppression, bias, segregation, marginalization, and any other harm within society? How? And how to avoid that?
- On the other hand, may it be explored to give voice, power, control to minorities? How?
- What social/soft skills a professional specialized in such a content needs to be successful? Are your students prepared to interact in a multinational team, for example?
- Who are the pioneers and role models within the discipline area? Are there any who personifies a type of diversity or minority? What if you talked about them throughout the classes? Or maybe, how about giving an assignment to the students to find out who they are? (note: role models are important to break stereotypes within IT professionals; e.g., not everyone is an antisocial white male youngster)

Solution 3: Foster discussion among students. Another solution is to create groups, projects, or student initiatives to discuss DEI aspects. For example, Rorrer et al. [44] present a research program

to increase the number of women with intersectional identities[12] within Grad studies. Again, in Brazil, WIT (see Footnote 8) has plenty of reports on this kind of initiative on gender diversity. Furthermore, as part of a minority group, students discussing DEI and exchanging experiences may also improve their sense of belonging [30], leading to more academic success.

Challenge B: How to formally include DEI into curriculum or syllabus? Granted, some colleagues may not feel comfortable with the aforementioned claims that DEI does not *need* to be formally within curriculum or syllabus to be taught in Computing disciplines and classes. After all, such documents give directions on skills, competences and the profile provided by the course.

Solution 4: Prepare the ground. The best solution is to reformulate the whole curriculum; which is very complex, takes time and people commitment and, hence, it is a long-term solution. A short-term goal is to prepare the ground for such new curriculum by adding DEI concepts throughout the disciplines now. Then, by the time the new curriculum building process starts, such concepts and their acceptance will be already in place, the building team will get input from successful cases (and failures as well) of discussing DEI, and will be able to make better informed decisions on how to properly update the curriculum on the DEI perspective.

4.2 Personal Perspective

4.2.1 Issue: lack of knowledge. Most Computing faculty members have a degree in Computing or related areas, plus experience (at varied levels) in teaching technical concepts. Adding a highly social, humanities topic as DEI to any technical material requires knowledge or specialized skills. Also, given DEI's currently trending status, there are many theories, methodologies, learning practices, etc. being published not only on academic venues (e.g., conferences and journals) but also on general media (e.g., newspapers and online platforms). Therefore, the actual issue may be beyond lack of knowledge, as it may also include an overload of potential reading material to acquire such knowledge. Nonetheless, *a person does not need a Master or a Ph.D. degree in diversity (equity and inclusion) in order to discuss about it or just to increase its awareness.*

4.2.2 Issue: lack of time plus extra overload. Universities already require much time of their faculty members. Many educators already face work-induced stress and burnout in their daily routines. Moreover, faculty members have life outside the job, which presents concerns of its own (family, health, money, love, leisure, and more). To top it all, many people had their lives turned upside-down due to COVID, and most countries faced unpredictable, horrible crises; indeed, the consequences of the pandemics will go on for years to come. With so much going on, having time to invest in one's career may become a privilege per se. It is then understandable that many faculty members may read this essay and think they are not gonna change anything in their classes because lack of time, and fear of extra burden. Nonetheless, *many educators are committed to education quality, are often updating their teaching material, and want to make positive impact in the lives of their students.*

4.2.3 Personal Solutions and Challenges. Such personal issues point out to the same solution: it is probably easier to discuss about DEI or DEI awareness by investing some time (but not years) in studying about it and using off-the-shelf material. Although straightforward, such an idea has many challenges, as discussed ahead.

Challenge C: How to discuss about DEI without a formal education on it? Again, discussing about DEI or DEI awareness does not require a formal degree. Often, common sense, proper mindset and empathy towards DEI shall be enough. Still, reading papers may help building confidence to tackle DEI within classes. The question then becomes: which papers exactly, within the myriad of material already published on the subject?

Solution 5: Read some high quality material. This is a personal list of DEI favorites, which are easy to read and understand:

- Blaser et al. [6] have lessons learned on disability & diversity;
- Garibay [15] gives good tips for a DEI-friendly environment;
- Moore et al. [35] go over ten roles for academic leaders to promote DEI in data science, which are easily applied to general Computing as well;
- Tychonievich and Cohoon [50] go over lessons learned while training teachers and professors about diversity, and most of such lessons also apply when one includes DEI into a class;
- and the papers listed in Solution 1 (Section 4.1.3).

Solution 6: Foster discussion among peers. Other faculty colleagues may also be going through the same doubts (hopefully!). Consider talking about DEI with those who teach the same disciplines or similar content. Also, take a look at how people from your institution humanities department approach the subject. Invite one (or more) to give a talk at your department with the goal of training Computing faculty on how to discuss or raise awareness about DEI.

Challenge D: How to spend minimum time on preparing material to discuss about DEI and avoid overload? This is probably the easiest or the hardest challenge. A direct solution is using off-the-shelf material, ready to be explored in class. Yet, educators may be reluctant in using others' material without any adaptation. The problem is when adapting requires more time than preparing it from scratch. As anything in life, practice makes perfect; maybe the first time one uses a material will not be the best experience possible, but it certainly will enable growth and open opportunities for improvements to be used in the next semester/quarter.

Solution 7: Get ready-to-use material. Wick [57] is one pioneer in proposing a coding task to raise diversity awareness. The idea is simple: divide the class in two groups; one develops a genetic algorithm with homogeneous solution, and the other includes diversity within the algorithm; everybody tests both solutions and measures their performance. Then, Zeitz and Anewal [58] introduce a repository with Computing assignments that deal with diversity and inclusion.[13] Its current version (Oct. 2021) has seven assignments on: color blindness design, gender gap, racial and cultural divides, unconscious bias, cultural effects on usability testing, diversity and inclusion in the Silicon Valley, and finding affordances.

[12] Women identified as African-American/Black, Hispanic/Latinx, American Indian/Alaska Native/Native American or Native Hawaiian/Pacific Islander.

[13] https://github.com/UMWComputerScience/CS_Diversity_Inclusion_Assignments

Solution 8: Adapt existing material. James and Hampton [25] present an interesting methodology for introducing programming concepts by using Black music. Such material could be adapted by using another regional music style (specially in Brazil, where regional music are an important cultural aspect for its people). Most works mentioned within Solution 1 may also be adapted.

Solution 9: Give the task to the class. Real learning usually requires students being actively involved and responsible for making sense of their experiences [51]. Anyone can rely on that claim and give the task of preparing class material to its students. In doing so, students learn way more than "just the class content" as many social skills are also involved. One practical idea is given by Trim and Nishad [49], who report two assignments within a grad level ethics class. Another idea is asking one of the questions from Solution 2 (Section 4.1.3) to the students and just mediate the discussion.

Challenge E. The devil's advocate. Few educators may still think: (*1*) my classes are technical-scientific, and DEI should be fully covered in a specific discipline, instead of just being lightly mentioned in mine; (*2*) including DEI in any Computing class taught by non trained people is as wrong as teaching music (or other off-the-topic content); (*3*) adding DEI to all Computing disciplines will make the content repetitive; and (*4*) having DEI taught in all Computing disciplines is preposterous. Such claims seem valid; yet, they show resistance to bringing teaching material to 2022+.

Solution 10: Add DEI to all Computing disciplines in which DEI make a difference, for better or worse. The arguments towards DEI presented in this essay now beg the question: are you sure the person teaching Ethics in your department has the whole background necessary to cover *all* complex perspectives of DEI within Computing? Also, going back to the issues raised in Challenge E, potential answers to those include the following.

(1) Computing disciplines will remain technical-scientific, DEI could be *better* explored in Ethics, but should *also* be mentioned or, preferably, discussed within any Computing content. This essay is *not* suggesting to change *all* Computing disciplines to add hours of DEI material in each. The idea is to discuss DEI in any class *where appropriate*.
(2) Who better than a HCI Master/PhD to teach about interface accessibility? Who better than a person specialized in Networks to discuss about how to make the high speed Internet reach the deeps of the Amazon rainforest or the country arid regions? Who better than a data scientist or a person specialized in data mining, machine learning, AI or databases to discuss data bias, and how such bias always benefits the majority of a population? I.e., bias works against minorities. Also, there are many problems in online social networks that could be covered by any educator with background on algorithms, graph theory, system modeling, and software engineering. Who better than a hardware person to teach about making customized hardware interfaces for the elderly?
(3) There will probably be some repetition. Nonetheless, the idea is *not* having the *same* content discussed the *same way* over and over. The goal is to add discussions about DEI in all classes in which such concepts make a difference. Giving that each Computing discipline has a unique purpose, such a discussion will be on a unique perspective as well, and most probably in one type of DEI (see examples in the previous item), then avoiding complete repetition. Moreover, some synchronization may be necessary (check Solution 6).
(4) Why? Why computing educators would not be allowed to raise awareness among their students about a significant society change (evolution) that is already having impact on many Computing-provided products and services, be it software or hardware? Besides the examples mentioned in item 2, an Ethics discipline should also cover other pressing matters: fake news, hate speech, stance detection, carbon footprints, energy consumption, algorithms interference on decision making, and much more. Now, how long such Ethics educator will need to study all the aforementioned concepts from such broad Computing areas? How many hours *one* single discipline shall have to properly cover them?

Also, many educators propose a final, larger project at the end of a discipline. Besides the technical part, DEI-oriented requirements include making sure the solution works on: slow, limited internet connection; two year old mobile devices running equally outdated operating systems; limited memory; minimum energy consumption; both desktop and mobile screens without loosing any user experience; and so on. Students must also be aware of: not every child has a mom and a dad; not every person has a legible fingerprint (e.g., elderly and cancer survivors); auto face recognition must work for people with different skin tones; and more.

A better solution is then having educators adding discussions about DEI on their disciplines *throughout the Computing curricula*. A starting point is having educators to ponder about the questions within Solution 2 and address DEI issues as needed. Ergo, this essay.

5 CALLS TO ACTION

This section finalizes the reasoning for discussing DEI or raising awareness within Computing education. It also includes further ideas on how to do it, separated by focus group.

For Computing Educators. As educators, we should grant our students access to DEI-oriented thinking, designing and coding skills. In time, through products and services they develop/offer, such students will build an IT industry/market that provides equal access to everyone, despite people's diversity attribute values. Of course, there are issues and challenges, but this essay pointed out to some doable solutions. Furthermore, there are different levels of discussion that could appear in undergrad and graduate courses – assuming that most ideas here could be implemented within undergrad disciplines. For graduate disciplines (i.e., as part of specialization, master and phd programs), the discussion could also include research initiatives that tailor software and hardware for minorities (e.g., accessibility). They could also cover innovation aspects brought to such products by DEI. Nonetheless, the ideas presented here shall serve for inspiration to any level of study.

For Computing Education Researchers. Many research studies within Computing Education present quantitative or qualitative analyses for evaluating solutions, initiatives, projects, or assessing current situations and giving historical perspectives. Nonetheless,

many of such analyses have no specific question on the respondents' gender, race, or any minority information, potentially due to ethics, legal or privacy concerns (e.g., [38]); whereas others do have the questions but do not discuss the answers divided by group (e.g., [10]). As researchers, we also must assess the situation of minorities within control and testing groups; which shall provide new perspectives and insights on how to truly improve diversity, equity and inclusion. One simple example: consider all research done on how students face the first coding or programming class within a university; consider also those evaluation questionnaires that do not assess the class performance by groups regarding gender, race, age, disability, and so on; any conclusion may be true for the class as a whole, but is it true for the minority groups as well? How can anyone be sure there is no Simpson's paradox[14] in the reported results? Assessing the minorities individually is paramount, or our research will still be *DEI-agnostic* within a world that has become **DEI-aware**. Note, it is *not* the intention here to question the validity of such studies; the goal is to open the researchers' mind to include such variables in their upcoming evaluations.

For Computing Professionals. Most universities enable their faculty members to establish projects with both industry and society representatives (e.g., *extension* projects). If there is any of such institutions near you, get in touch with their computing department. There are mutual benefits to be explored in many ways.

For Computing Organizations. Figure 4 informs being out of the curriculum as the main reason to not cover DEI issues within classes, whereas Solution 4 suggests educators prepare the ground to remedy such reason. Now, this endeavour should be backed up by organizations (such as ACM and SBC) for a more effective outcome. Indeed, such organizations should support any initiative related to the matter (watch [39]). Specially, Solutions 5 (read high quality material), 7 (get ready-to-use material), and 8 (adapt existing material) may also benefit from organizations, which could build (or support) a repository for DEI-oriented teaching material. They could also open space in their media and events to discuss issues and solutions, as those presented here (which are just a first step).

6 CONCLUDING REMARKS

Summary. This essay discussed an overview of the vast literature on diversity, equity and inclusion, emphasizing Computing education. A systematic literature review is left as *future work*, because it requires a larger team to work on and more interdisciplinary discussion among computing, humanities and social educators – a huge challenge per se. It also summarized an initial survey on how computing educators cover (or not) DEI issues in their disciplines – deeper analyses of results are future work. Half of the respondents mentions DEI aspects in their classes, most of whom teach social-oriented subjects. Those who do not cover DEI mostly agree that it is relevant, and point out the following reasons for such behavior: DEI being out of curriculum/syllabus and having no connection to class content, and the person lacking knowledge or time to cover them. The essay restated such reasons as issues and challenges, also providing solutions such as: getting off-the-shelf material to use or adapt, and adding DEI to all Computing disciplines in which DEI make a difference. Finally, this essay also presented calls to action for educators, researchers, IT professionals and organizations.

Conclusion. Overall, a better world is in our reach, if we (educators, researchers and professionals) do our jobs as needed by a currently flawed society. Adding different perspectives on diversity, equity and inclusion in all Computing disciplines in which such concepts matter is the initial step towards educating more wholesome IT professionals. In time, DEI will be so mainstream that it will not need any special attention – and that is the ultimate goal.

Limitations. The discussion on DEI may go way beyond what is presented in this essay. Aspects not covered here include: institutional initiatives, infrastructure issues and disability challenges [6], culturally relevant Computing pedagogy [33], specific education methodologies such as game-based [21], DEI at school level Computing [59], and open source community benefits [56].

Acknowledgements. The author thanks the reviewers, as well as Michele A. Brandão, Clodoveu A. Davis Jr., Ana Paula Couto da Silva, and André C. Nácul, for their thoughtful comments and suggestions; the survey respondents whose answers inspired the definition of educators' issues regarding DEI; and *CNPq* (National Council for Scientific and Technological Development), which has frequently provided funding for her research and diversity-oriented initiatives. Finally, heartfelt thanks to the many colleagues and students who have unknowingly motivated the writing of this essay, specially the *Meninas Digitais*[15] (Digital Girls) community.

ANNEX – GLOSSARY

This annex presents a brief glossary of terms as defined by UN and UNESCO [52, 53] within the context of *education*.

Diversity. People's differences which may relate to their race, ethnicity, gender, sexual orientation, language, culture, religion, mental and physical ability, class, and immigration status.

Equity. Ensuring that there is a concern with fairness, such that the education of all learners is seen as being of equal importance.

Gender Equality. The understanding that women and men have equal conditions for realizing their full human rights and for contributing to, and benefiting from, economic, social, cultural and political development [53]. The equal rights, autonomy, responsibilities and opportunities of women and men, and that the rights, responsibilities, and opportunities of individuals will not depend on whether they are born male or female; the power dynamics between women and men based on equality [52].

Gender Equality at Workplace. Workplace culture and practices that value female and male workers equally with no gender-based discrimination, and that ensure safe and enabling environment for all individuals to perform their functions with equal pay and equal opportunities.

Gender Diversity. Having a fair representation/proportion of all genders in an environment.

Gender Inclusion. All individuals, regardless of whether they are born male or female, have a sense of belonging and empowerment, equal access to opportunities and equal participation in activities, including in the decision-making of an institution or community.

Inclusion. A process that helps to overcome barriers limiting the presence, participation and achievement of learners.

Inclusive Education. Process of strengthening the capacity of the education system to reach out to all learners.

Integration. Learners labelled as having 'special educational needs' are placed in mainstream education settings with some adaptations and resources, but on condition that they can fit in with pre-existing structures, attitudes and an unaltered environment.

Special Education. Classes or instruction designed for students categorized as having special educational needs.

Special Educational Needs. A term used in some countries to refer to children with impairments that are seen as requiring additional support.

[14] Simpson's paradox is a phenomenon in which a trend appears in many groups of data but disappears or reverses when the groups are combined [7]. Or, the trend appears in the population as a whole (i.e., the whole class), but not within all individual, grouped parts (i.e., minorities).

[15] https://meninas.sbc.org.br

REFERENCES

[1] Muhammad Ali et al. 2019. Discrimination through Optimization: How Facebook's Ad Delivery Can Lead to Biased Outcomes. In *CSCW*. ACM, New York, USA. https://doi.org/10.1145/3359301.

[2] Renata Araujo et al. 2019. *Referenciais de Formação para os Cursos de Pós-Graduação Stricto Sensu em Computação 2019.* SBC, Porto Alegre, Brazil.

[3] Lotte Bailyn. 2003. Academic Careers and Gender Equity: Lessons Learned from MIT. *Gender, Work and Org.* 10, 2, 137–153. https://doi.org/10.1111/1468-0432.00008.

[4] Ross J. Benbow and Erika Vivyan. 2016. *Gender and Belonging in Undergraduate Computer Science: A Comparative Case Study of Student Experiences in Gateway Courses.* Technical Report WCER No. 2016-2. Un. Wisconsin–Madison.

[5] Katerina Bezrukova et al. 2016. A meta-analytical integration of over 40 years of research on diversity training evaluation. *Psychological Bulletin* 142, 11, 1227–1274. https://doi.org/10.1037/bul0000067.

[6] Brianna Blaser et al. 2018. Including Disability in Diversity. In *RESPECT*. 1–4. https://doi.org/10.1109/RESPECT.2018.8491717.

[7] Colin R. Blyth. 1972. On Simpson's Paradox and the Sure-Thing Principle. *JSTOR* 67, 338, 364–366. https://doi.org/10.2307/2284382

[8] Leah Buechley et al. 2008. The LilyPad Arduino: Using Computational Textiles to Investigate Engagement, Aesthetics, and Diversity in Computer Science Education. In *SIGCHI*. ACM, 423–432. https://doi.org/10.1145/1357054.1357123.

[9] Americo B. Cunha and Alberto G. Canen. 2008. Requirements gathering in information technology: a Cross-cultural perspective. In *ProComm*. IEEE, 1–8.

[10] Reudismam de Sousa et al. 2021. Investigando as Dificuldades e Perspectivas sobre um Curso de Engenharia de Software de Dois Ciclos: Um Survey com a Visão Discente. In *EduComp*. SBC. https://doi.org/10.5753/educomp.2021.14471.

[11] ACM Data Science Task Force. 2021. *Computing Competencies for Undergraduate Data Science Curricula.* ACM.

[12] CC2020 Task Force. 2020. *Computing Curricula 2020: Paradigms for Global Computing Education.* ACM. https://doi.org/10.1145/3467967.

[13] Yuka Fujimoto and Jasim Uddin. 2021. Inclusive Leadership for Reduced Inequality: Economic–Social–Economic Cycle of Inclusion. *Journal of Business Ethics* online. https://doi.org/10.1007/s10551-021-04920-2.

[14] Kelly Gaither. 2017. How Visualization Can Foster Diversity and Inclusion in Next-Generation Science. *IEEE Comput Graph Appl* 37, 5, 106–112. https://doi.org/10.1109/MCG.2017.3621230.

[15] Juan C. Garibay. 2015. *Creating a Positive Classroom Climate for Diversity.* UCLA Faculty Diversity & Development, Los Angeles, CA, USA. https://equity.ucla.edu.

[16] Vinícius P. Gonçalves et al. 2011. Interação de Idosos Com Celulares: Flexibilidade Para Atender a Diversidade. In *IHC*. SBC, Porto de Galinhas, PE, Brazil, 343–352.

[17] Joanna Goode. 2008. Increasing Diversity in K-12 Computer Science: Strategies from the Field. *SIGCSE Bull* 40, 1. https://doi.org/10.1145/1352322.1352259.

[18] Mariam Guizani et al. 2020. Gender Inclusivity as a Quality Requirement: Practices and Pitfalls. *IEEE Softw.* 37, 6. https://doi.org/10.1109/MS.2020.3019540.

[19] David A. Harrison and Katherine J. Klein. 2007. What's the difference? diversity constructs as separation, variety, or disparity in organizations. *Academy of Management Review* 32, 4, 1199–1228. https://doi.org/10.5465/amr.2007.26586096.

[20] David A. Harrison and Hock-Peng Sin. 2006. What Is Diversity and How Should It Be Measured? In *Handbook of workplace diversity*, A. M. Konrad et al. (Eds.). Sage, Newbury Park, CA, 191–216. https://doi.org/10.4135/9781848608092.n9.

[21] Casper Harteveld et al. 2020. Gaming4All: Reflecting on Diversity, Equity, and Inclusion for Game-Based Engineering Education. In *FIE*. IEEE, Uppsala, Sweden, 1–9. https://doi.org/10.1109/FIE44824.2020.9274176.

[22] Erika L. D. Head et al. 2021. Improving Diversity, Equity, and Inclusion in Doctoral Computing Education. In *SIGCSE*. ACM, Virtual Event, USA, 764–765. https://doi.org/10.1145/3408877.3432577.

[23] Sylvia Ann Hewlett, Melinda Marshall, and Laura Sherbin. 2013. How diversity can drive innovation. *Harvard Business Review* December.

[24] Vivian Hunt et al. 2018. *Delivering through diversity.* Technical Report. McKinsey & Company. https://www.mckinsey.com/business-functions/organization/our-insights/delivering-through-diversity.

[25] David James and Lelia Hampton. 2020. Using Black Music as a bridge to understanding introductory programming concepts. In *RESPECT*. IEEE, Portland, Oregon, 1–4. https://doi.org/10.1109/RESPECT49803.2020.9272409.

[26] W. Brad Johnson and David G. Smith. 2021. Advancing Gender Equity as You Lead out of the Pandemic. *Harvard Business Review* October.

[27] Keith Kirkpatrick. 2021. Algorithmic Poverty. *Commun. ACM* 64, 10, 11–12. https://doi.org/10.1145/3479977.

[28] Marina Krakovsky. 2021. A Model Restoration. *Commun. ACM* 64, 9, 13–15. https://doi.org/10.1145/3474353.

[29] Äli Leijen et al. 2021. The Dilemma of Inclusive Education: Inclusion for Some or Inclusion for All. *Fronts Psych.* 12, 3925. https://doi.org/10.3389/fpsyg.2021.633066.

[30] Colleen Lewis et al. 2019. Alignment of Goals and Perceptions of Computing Predicts Students' Sense of Belonging in Computing. In *ICER*. ACM, Toronto ON, Canada, 11–19. https://doi.org/10.1145/3291279.3339426.

[31] Robert Livingston. 2020. How to Promote Racial Equity in the Workplace. *Harvard Business Review* September-October.

[32] Ana Luiza Lorens et al. 2020. Participação Feminina em Comitês de Programa de Simpósios da Computação. In *WIT* (Cuiabá). SBC, Porto Alegre, RS, Brazil, 90–99. https://doi.org/10.5753/wit.2020.11279.

[33] Tia C. Madkins et al. 2019. Culturally Relevant Computer Science Pedagogy: From Theory to Practice. In *RESPECT*. IEEE, 1–4. https://doi.org/10.1109/RESPECT46404.2019.8985773.

[34] Ana Luíza Milson et al. 2020. Elas na Ciência: Website com Jogos para Divulgar Personalidades Femininas. In *WIT* (Cuiabá). SBC, Porto Alegre, RS, Brasil, 10–19. https://doi.org/10.5753/wit.2020.11271.

[35] Jason H. Moore et al. 2021. Ten important roles for academic leaders to promote equity, diversity, and inclusion in data science. *BioData Mining* 14, 22. https://doi.org/10.1186/s13040-021-00256-9.

[36] Vânia Paula de Almeida Neris et al. 2021. Addressing Brazilian diversity in personal computing systems with a tailoring-based approach. *Pers Ubiquit Comput* 25, 297–319. https://doi.org/10.1007/s00779-020-01444-w.

[37] Joint Task Force on Cybersecurity Education. 2018. *Cybersecurity Curricula: Curriculum Guidelines for Post-Secondary Degree Programs in Cybersecurity.* ACM.

[38] Roberto Pereira, Leticia Peres, and Fabiano Silva. 2021. Hello World: 17 habilidades para exercitar desde o início da graduação em computação. In *EduComp*. SBC. https://doi.org/10.5753/educomp.2021.14485.

[39] Timothy M. Pinkston. 2021. Valuing Diversity, Equity, and Inclusion in Our Computing Community. https://www.acm.org/diversity-inclusion/dei-in-computing.

[40] Martin Reeves, Leesa Quinlan, Mathieu Lefèvre, and Georg Kell. 2021. How Business Leaders Can Reduce Polarization. *Harvard Business Review* October.

[41] Karen Ribeiro et al. 2019. Uma análise de gênero a partir de dados da Sociedade Brasileira de Computação. In *WIT* (Belém). SBC, Porto Alegre, Brazil, 159–163. https://doi.org/10.5753/wit.2019.6729.

[42] Laura Ribeiro et al. 2019. Um Panorama da Atuação da Mulher na Computação. In *WIT*. SBC, Belém, Brazil, 1–10. https://doi.org/10.5753/wit.2019.6707.

[43] Lauren Romansky et al. 2021. How to Measure Inclusion in the Workplace. *Harvard Business Review* May.

[44] Audrey Rorrer et al. 2021. Understanding Immersive Research Experiences That Build Community, Equity, and Inclusion. In *SIGCSE*. ACM, Virtual Event, USA, 149–155. https://doi.org/10.1145/3408877.3432523.

[45] Natália Pinheiro Ramos de Souza and Kiev Gama. 2020. Diversity and Inclusion: Culture and Perception in Information Technology Companies. *IEEE Revista Iberoamericana de Tecnologias del Aprendizaje* 15, 4, 352–361. https://doi.org/10.1109/RITA.2020.3033254.

[46] Ramya Srinivasan and Ajay Chander. 2021. Biases in AI Systems. *Commun. ACM* 64, 8, 44–49. https://doi.org/10.1145/3464903.

[47] Simone Stumpf et al. 2020. Gender-Inclusive HCI Research and Design: A Conceptual Review. *Found. Trends Hum. Comput. Interact.* 13, 1, 1–69. https://doi.org/10.1561/1100000056.

[48] Hannah Thinyaner. 2021. Remaining Connected Throughout Design. *Commun. ACM* 64, 10, 22–24. https://doi.org/10.1145/3481429.

[49] Michelle D. Trim and Hadi Nishad. 2019. We Learn by Doing: Modeling Inclusive Pedagogy in a Graduate CS Ethics Course. In *RESPECT*. IEEE, Minneapolis, MN, USA, 1–2. https://doi.org/10.1109/RESPECT46404.2019.8985698.

[50] Luther Tychonievich and James P. Cohoon. 2020. Lessons Learned from Providing Hundreds of Hours of Diversity Training. In *SIGCSE*. ACM, Portland, OR, USA, 206–212. https://doi.org/10.1145/3328778.3366930.

[51] Alice Udvari-Solner. 1996. Theoretical Influences on the Establishment of Inclusive Practices. *Cambridge Journal of Education* 26, 1, 101–119. https://doi.org/10.1080/0305764960260108.

[52] UNDP. 2021. *Gender Diversity and Inclusion for a Fair Business Environment.* UN Development Programme, NYC, USA. Available at: https://www.undp.org/publications/gender-diversity-and-inclusion-fair-business-environment.

[53] UNESCO. 2017. *A guide for ensuring inclusion and equity in education.* UNESCO, Paris, France. Available at: https://unesdoc.unesco.org/ark:/48223/pf0000248254.

[54] Monique Volman and Edith van Eck. 2001. Gender Equity and Information Technology in Education: The Second Decade. *Review of Educational Research* 71, 4, 613–634. https://doi.org/10.3102/00346543071004613.

[55] Kendra Walther and Richard E. Ladner. 2021. Broadening Participation by Teaching Accessibility. *Commun. ACM* 64, 10, 19–21. https://doi.org/10.1145/3481356.

[56] Judy Weng and Christian Murphy. 2018. Bridging the Diversity Gap in Computer Science with a Course on Open Source Software. In *RESPECT*. IEEE, 1–4. https://doi.org/10.1109/RESPECT.2018.8491720.

[57] Michael R. Wick. 2009. Using Programming to Help Students Understand the Value of Diversity. In *SIGCSE*. ACM, Chattanooga, TN, USA, 367–371. https://doi.org/10.1145/1508865.1508997.

[58] Jessica Zeitz and Karen Anewalt. 2021. Creating a Repository of Diversity and Inclusion Assignments for Computer Science. In *SIGCSE*. ACM, Virtual Event, USA, 1321. https://doi.org/10.1145/3408877.3439654.

[59] Ninger Zhou, Debra Richardson, and Mark Warschauer. 2018. Promoting High School Teachers' Self-efficacy and the Understanding of Equity Issues in CS Classrooms. In *RESPECT*. 1–8.

[60] Avelino F. Zorzo et al. 2017. *Referenciais de Formação para os Cursos de Graduação em Computação.* SBC, Porto Alegre, Brazil.