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Working with Diversity in Informatics

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Abstract: Diversity is a term that is broadly used and challenging for informatics research, development and education. Diversity concerns may relate to unequal participation, knowledge and methodology, curricula, institutional planning etc. For a lot of these areas, measures, guidelines and best practices on diversity awareness exist. A systemic, sustainable impact of diversity measures on informatics is still largely missing. In this paper I explore what working with diversity and gender concepts in informatics entails, what the main challenges are and provide thoughts for improvement. The paper includes definitions of diversity and intersectionality, reflections on the disciplinary basis of informatics and practical implications of integrating diversity in informatics research and development. In the final part, two concepts from the social sciences and the humanities, the notion of "third space"/hybridity and the notion of "feminist ethics of care", serve as a lens to foster more sustainable ways of working with diversity in informatics.

Keywords: Gender; Diversity; Intersectionality; Sociotechnical Design; Informatics

1 Introduction

Diversity poses a challenge for informatics research, development and education on various levels. Most commonly, lack of diversity in terms of participation in the technical field is named as one major and persisting problem. In Western countries in particular, gender imbalances and lack of representation of BIPOC

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are problematic [Mc18][2]. These disparities in participation are increasingly viewed not only as a problem of gender equity policy making. In addition, these inequalities stand in the way of socially accepted technology and product developments that are usable for all. Therefore, not considering inequalities is also economically harmful [Pe16]. A lack of sensitivity towards social categories (gender, race, class etc.) in their interplay with IT system design can lead to the perpetuation of stereotypes, incomplete requirements and bias in data sets and AI systems. Biases take on a life of their own once they are inscribed into digital technologies. They only become visible when a product or service cannot be used by all people – or when the effects of such discriminatory systems are revealed [Eu18; Wa17]. IT systems that do not account for diversity regarding user groups, people affected and contexts may not function properly or may even have discriminatory effects and hence need to be adjusted or redeveloped. This is neither economically nor socially or ecologically sustainable.

The term diversity is broadly used in informatics. Depending on the context, diversity may relate to: questions of access to and participation in academia and the job market; knowledge, theories and methods developed, taught and used; curricula building, teaching style and content; institutional planning and structuring. For all of these areas, measures, guidelines and best practices on how to promote and integrate diversity exist[3]. Despite this rich body of expertise, a lasting impact and fundamental consideration of the role of diversity in informatics leaves something to be desired.

This gap between the existing expertise on diversity and its practical implementation I take up as a starting point. This paper wants to explore what working with diversity in informatics entails and also provide some ideas on how this "working with" could be made more sustainable. The paper starts with explaining diversity and introduces the concept of intersectionality. This part serves as a background for identifying connecting points for a systemic approach for working with diversity in informatics. The focus provided here is twofold. First, the epistemic grounds for working with diversity in informatics are considered. Gender and diversity are social aspects. Hence, whether social

2 BIPOC stands for Black, Indigenous, People of Color. These self-designated terms have their origins primarily in US-American and Canadian activism. For debates on gender inequality, see also the Third Gender Equality Report of the German Federal Government on digitalization: https://www.dritter-gleichstellungsbericht.de/en

3 This is just a very small selection of initiatives from the US-American and German context: https://genderedinnovations.stanford.edu, https://www.gender-wissen-informatik.de/, https://www.fix-it.tu-berlin.de/fix-it-fixing-it-for-women/

aspects can be located at the core of informatics or not, is crucial for working with gender and diversity in the field. Second, the practical implications of working with diversity are taken up. This section is limited to sociotechnical design approaches and presents a process model that integrates gender and diversity knowledge into informatics research and development. The final part of the paper comes back to the question why, despite a rich body of knowledge, centering diversity in informatics continues to be challenging. For one, the structural integration, a mainstreaming of gender and diversity expertise, is important. This structural integration, however, also needs to come alive and translate into respective workplace and disciplinary cultures. Put differently, there need to be people who care for diversity, and there must be support for those who do the actual work. These key points, structural integration and diversity aware disciplinary culture, could benefit from two concepts I want to introduce briefly in the following.

Gender and diversity expertise in informatics means working with approaches from the social sciences and the humanities. A successful structural integration requires space and resources that allow to navigate between social and technological disciplines. The concept of the "third space" and its notion of hybridity by Homi. K. Bhaba could be useful here [Bh94]. Bhaba's work deals with the relation between different cultures in the context of colonization. His theoretical work has since been highly influential to understand encounters between heterogeneous cultural contexts. In informatics, the "third space" is taken up in human-computer interaction by participatory design approaches [Mu02]. In the context of these approaches the technical world of developers and the social world of the users of a technology are seen as two cultures. The "third space" serves as an actual physical space and as a methodological concept. It is a space where neither culture is at home and where communication and a shared understanding need to be established first. Hybridity points to the importance of knowledge being co-created in this space. The objective is that through co-creating, new methods, measures and guidelines emerge that would not be possible otherwise[4].

After introducing the first concept referring to the "third space" above, I now cover the second concept referring to care work. When care is mentioned in informatics, it is usually done so in relation to the health care industry, patient care, assisted living or else as a domain where IT supports societal care work. Considered an application area, care appears as external to the field

4 For a full discussion on hybridity in human-computer interaction see [DK22].

of informatics. This fits the two cultures of the social and technical world mentioned above. The “feminist ethics of care” scholarship introduces a new, broadened understanding of care. The aim of the concept is “to change the overall value of care” [Tr98]. In their analysis the authors reconfigure what is commonly understood as “caring”. Historically, in Western countries caring is linked to reproductive labor, a perspective reinforcing the separation between public and private spheres and the interlinked gendered (as well as class-based) division of labor contributing to the devaluation of care work. Instead, Joan C. Tronto and Berenice Fisher view care as a basic human activity, defined as “a species activity that includes everything that we do to maintain, continue and repair our “world” so that we can live in it as well as possible” [TF90].

In the final section of this paper, I will come back to both concepts with a brief reflection on how they could be beneficial for working with diversity in informatics. I also want to note that the perspective taken up in this paper is marked by my situatedness in a Western European educational institution. My findings are informed by almost two decades of teaching and research experience in informatics and engineering faculties at German universities as well as by a mostly Western body of work dealing with the question of gender and diversity in STEM disciplines.

2 Notes on diversity and intersectionality

This section introduces the key terminology used in this paper. The section starts with diversity as a term which is more commonly used and also broader in conception than intersectionality. Intersectionality is then introduced as a concept that, in its specificity, differs from and goes beyond diversity.

2.1 Diversity

As a social concept, diversity describes the heterogeneity of human existence – it serves to simultaneously recognize and appreciate differences [Ve15]. In comparison to gender inequality, discussions on diversity are relatively new in the European context. They have been promoted through diversity debates in the USA and have impacted the private and the public sector [HV07].

Diversity gained wider recognition in particular through diversity management in the private sector, in international companies and also in public institutions. Most prominently, the figure of the "diversity wheel" is used to describe diversity through four layers which appear when read from inside to outside as follows: the first layer, *personality*, refers to psychological traits; the second layer, *internal dimension*, includes social markers such as age, gender, race, sexual orientation, physical ability; the third layer, *external dimension*, contains income, personal habits, religion, geographic location, work experience, appearance, parental status; the fourth layer, organizational dimension, relates to functional level, work content field, division, department, unit, group, seniority, work location, union affiliation, management status [GR03]. The wheel serves to make diversity traits perceptible, for example in the context of the treatment of employees. The approach can be used to map a given context and help set up practical solutions. In a nutshell, diversity management views the heterogeneity of human traits, experiences and backgrounds as a valuable resource for modern organizations and corporations. If managed accordingly, diversity in the work place produces better results and promotes innovation [RG16], [Pe16]. In contrast, the lack of human diversity in the tech field has been linked to social bias and problematic effects of IT development [Cr19].

In the public sector, diversity relates to measures facilitating democratic rights and values, such as equal opportunity, anti-discrimination and inclusion, with extended guidelines for educational institutions [CJS19]. Most European higher education institutions have set up a diversity strategy. Gaisch and Aichinger provide an elaborated adaption of the diversity wheel at an Austrian university of applied science pursuing a holistic approach which aims for structural change [GA16].

In STEM, with informatics being no exception, most pressingly the persisting gender imbalance throughout all career stages has been on the agenda for decades [Be20]. Here, diversity allows for an opening of the discussion towards other social markers beyond or in interconnection with gender. In informatics education, diversity raises awareness of different learning and teaching styles, ways of acquiring and mediating knowledge and recognizing plurality in methods and tools [Sa17], [Ha17]. Furthermore, in informatics research and development, the concept helps to acknowledge diversity in contexts and application fields [St11].

2.2 Intersectionality

In comparison to diversity, the concept of intersectionality is lesser known, at least beyond academia. US-American legal scholar and civil rights activist Kimberlé Crenshaw coined the term using the metaphor of a traffic intersection to highlight that social categories are not neatly separated but that instead their intersections mark how a person is situated in society. The cause for Crenshaw's work was the finding that US anti-discrimination laws do not benefit Black women because the laws do not acknowledge multiple causes of discrimination [Cr89]. Intersectionality is based on Black feminist activism, authorship and scholarship [Co01; ho81; Lo01; Tr01]. The concept focuses on questions of power, hierarchies, in- and exclusion and their constitutive force for organizations, institutions and infrastructures. Hence, intersectionality connects structural systemic oppression, individual experience and the symbolic order [RM16].

With diversity social categories can appear as additives. Intersectionality views social categories as interdependent and inherently addresses sociopolitical dimensions. This interdependence complicates an easy application of intersectional analysis and calls for an elaborate reconfiguring of data collection [DHK22]. This would not simply entail the gathering of separate identity markers (gender, race, class etc.) but instead requires relating these markers to one another while also factoring in their sociopolitical context and specific situatedness [Yu06]. What it means to be a Black migrant woman in Germany, for example, or a Black woman born in Germany, may vary[5].

Like diversity, intersectionality may also serve to expand discussions on gender inequalities in informatics. Intersectionality, however, differs from diversity in its practical application. For example, intersectionality still appears as a challenge for European gender mainstreaming or equal opportunity measures:

> "The concept of intersectionality, referring to persons who identify with various dimensions of diversity (e.g., a female researcher in engineering who has a migration background or first-generation student coming in through an alternative pathway and having caring responsibilities) is known and mentioned by some, but not often addressed in the institutional strategies or practice. Some institutions see addressing intersectionality as a qualitative next step forward in their work on the agenda." [CJS19]

5 Cf. GERD – Gender-extended Research and Development Model, https://www.gerd-model.com

It is important to note that initiatives exist that provide expertise on the practical use of intersectionality, such as the Opportunity Agenda [TO21].

Because gender imbalance in STEM is such a pressing topic, other forms of exclusion have often been neglected, especially in Western European debates [BD20]. Furthermore, with its focus on power relations, intersectional analysis interrogates hierarchical structures and problematizes social inequalities. Where diversity management celebrates differences or treats them as a resource for innovation, intersectionality aims at a more radical restructuring towards social justice [DK12]. Emphasizing intersectionality helps reveal power relations and broadens the discussion of diversity. In the following, I will mostly speak of diversity because of its broader meaning and more common usage but also build on the powerful concept of intersectionality.

3 Connecting diversity and informatics

This section begins with the question of what makes working with diversity in informatics possible (or impossible). First, what constitutes informatics as an academic discipline is discussed. Then, design approaches as well as a practical example of a process model that integrates gender and diversity knowledge into informatics research and development are provided.

3.1 Discussing informatics

In the following, the question of "what is informatics?" is discussed together with the possibility of addressing social aspects as an integral part of the discipline. It is the latter that forms the precondition for working with diversity concepts in the field.

Among the technical sciences, informatics holds a special position. Compared to other engineering fields, it is a relatively young academic discipline. In the German context, the first study programs were established in the late 1960s as informatics in the FRG or as mechanical computer engineering in the GDR. Interestingly, according to the Fakultätentag[6], the proportion of women was comparatively high in the early phase, in contrast to other technical sciences like

6 The Fakultätentag is the association of the departments or faculties of informatics of the universities and higher education institutions in Germany, see https://www.ft-informatik.de/

mechanical or electrical engineering – but this development did not last [VF18]. Various scholars draw a connection between shifts in what is understood to be the disciplinary basis of informatics and the participation of women. According to these findings, understanding informatics as an engineering science has got exclusionary effects on women [Ba06; Sc04; Sc14].

Since the early years, what constitutes informatics and its classification in the academic landscape have been widely discussed. Debates include analyzing the historical origins as well as the discipline's content [Be14; Co04; MW06; Sc14]. In its foundation, informatics is already inherently interdisciplinary through the novel combination of mathematics, natural sciences and engineering. Furthermore, informatics integrates linguistics as well as social, communication and information science components and borrows from cognitive science, psychology and law, among others. The digital transformation of almost all life domains requires the inclusion of further application areas and gives rise to combined fields, such as bioinformatics, business informatics, environmental informatics etc. On the one hand, these combinations refer to specific domain expertise or to other scientific disciplines. On the other hand, they also show what needs to be made visible because it does not appear to be anchored in the core of the discipline. Wolfgang Coy describes the genesis of informatics as an academic discipline as a process of boundary making, of in- and exclusion of topics, methodology and approaches. New combined fields show that topics which have previously been excluded can be included again when digital transformations call for it. Still, dividing lines and hierarchical valences between what is understood as core informatics and what counts as peripheral areas remain [Co04]. Considering diversity, it is noteworthy that the visibility of social aspects, and in particular informatics' relevance for application domains, correlates with increased participation of women in informatics. In comparison, many combined fields, especially such as media informatics or health informatics, have a higher proportion of female students [VF18].

Areas such as computing and society, fields like socio-informatics and human-computer interaction explicitly highlight social aspects of informatics. Socio-informatics in particular emphasizes the double character of computational developments. Computational artefacts must follow the formal logic of computing machinery as well as they need to function in the social world [RW11]. This double character of computational artefacts, or, put differently, the relationship between sign/signal-processing and embeddedness in the social world, marks the uniqueness of informatics. This is also expressed in the

conception of informatics as "engineering humanities" according to German informatics pioneer Friedrich L. Bauer [He04].

From the mid-1980s onwards, discussions around "women, work and computerization" drew connections between the unique character, respectively the epistemology, of informatics and the potential to focus on gender aspects[7]. Among others Christiane Funken stated that because informatics formalizes work flow processes, computational development tightly couples social and technical aspects [Fu93]. This also means that intersectional gender inequalities find their way into technical system developments. If made visible and reflected upon, possible discriminatory effects of IT development can be extenuated or avoided [DM18]. Furthermore, Heidi Schelhowe formulated that fundamental differences in the understanding of the computer as either an information or data processing machine are decisive for such an inclusion or exclusion of social aspects in the field of informatics. If the role of the computer is data processing then semantic understanding is attributed to humans. In this view, human (or social) agency and machine agency are tightly coupled. The more the scientific understanding of informatics is able to locate social aspects within the center of the discipline and not just at the peripheries, the more gender and diversity aspects can be viewed as an integral part and hence connected to knowledge and methodological questions at the core of informatics [Sc96]. Such a sociotechnical perspective allows to address diversity not just in terms of gender imbalances in the field but also in regards to knowledge, methodology, development, curricula building and disciplinary culture.

3.2 Implications for IT system design

As noted above, there are some areas of informatics that make it easier to establish connections for working with social aspects than others. Historically, debates around software development practices following the so-called software crisis in the late 1960s and early 1970s initiated shifts such as highlighting the importance of non-expert users as well as a context-, usage- and value-orientation of IT system design in general. Participatory and sociotechnical

7 See the proceedings of the 1st IFIP work group conference: [OSM85], and for the German context the work group "Frauenarbeit und Infomatik" (Women's Work and Informatics, now Women and Informatics) of the German association for informatics: https://fg-frauen-informatik.gi.de/

design approaches [Ak95; KG13] were (and are) an entry point for gender aspects and feminist values in software development processes [Ba06]. The field of human-computer interaction prominently highlights human factors. Heterogeneity in application domains, user groups and different expertise levels makes dealing with diversity on the level of content and the methods used indispensable. Furthermore, pervasive digital transformation and the rise of AI technology call for IT development that is socially acceptable and adheres to democratic norms and values [DHK22].

When designing and developing IT systems the question remains what the practical implications of a sociotechnical approach are and even more so when it comes to working with gender and diversity concepts. Intersectional gender research is rooted in the social sciences and the humanities. Therefore, using concepts, knowledge and methodology from these fields in informatics requires connecting points and working at translations and adaptions.

In informatics, and especially in human-computer interaction, there is a long tradition of collaborative and participatory software development practices. These approaches serve to bridge the gap between developers and users. Participatory design in particular addresses power and hierarchical relations in technology development and turns the intersection of work or activities in application domains and work in IT development into a productive exchange [TI13; WBS10]. In the Western European context, the approach dates back to Scandinavian projects of the 1970s that aimed to link the technological transformation of the workplace with democratic values and to increase the acceptance of technological tools – both in society and for the individual users [Su11]. Participatory design is not feminist per se, but it is critical of power and allows to reflect on what is included and what is not in IT system design. If intersectional gender expertise is combined with participatory design, unequal power relations that shape application domains and work conditions can be made visible and accounted for in development processes [We96].

Another design approach worth exploring is value-sensitive design. This approach aims at systematically introducing values and norms into sociotechnical design processes. Against the background of long-standing discussions about value orientation in informatics, Batya Friedman developed a theory-based design pattern for realizing democratic values in IT system development. This extends the focus of human-centered design, which is often reduced to usability questions, to questions of social acceptability and ethics of IT [Fr97].

As with participatory design, gender equity and anti-discrimination must first be recognized as important values.

In the past decade, approaches that bring together anti-discrimination, gender equity and IT design have been developed. The anti-oppressive design approach, for example, translates Patricia Hill Collin's work on racial justice[8] and the concept of systemic oppression of marginalized groups into a design framework for IT systems [SD14]. The framework connects structural, institutional levels of oppression and marginalization to technology development.

Another approach is the "Gendered Innovations" project initiated by Londa Schiebinger, which has received wider recognition internationally. Here, a methodological framework for integrating the gender dimension into STEM was created. The public website provides low-threshold access to a broad knowledge base that offers methods, clarification of terms and case studies.[9]

While Gendered Innovations aims to address all STEM fields, the Gender-Extended Research and Development Model (GERD)[10] is specific to informatics research and development. The origin of the model lies in an interdisciplinary project that brought together gender research and informatics. The project exemplified that intersectional gender expertise and a focus on diversity enriches informatics research, development and teaching. It highlights the relevance of social inequalities and power relations in regard to informatics; in IT design it helps to develop a realistic representation of application domains, strengthens the participation of marginalized groups and helps to consider the societal impact of technology [Ze14]. Within the project, however, we found, that concretizing gender knowledge so that it becomes operationalizable within informatics research and development is a challenging task. Ideally, project work in informatics would include intersectional gender experts as well as experts from application domains. However, this is not realistic. Hence, the GERD model takes up specific work practices and modalities in informatics and couples them with expert knowledge from intersectional gender research. This is done through taking up the form of process models in software engineering. The GERD model tracks IT research and development phases from

8 "Racial justice is the systematic fair treatment of people of all races, resulting in equitable opportunities and outcomes for all. Racial justice — or racial equity — goes beyond 'anti-racism'. It is not just the absence of discrimination and inequities, but also the presence of deliberate systems and supports to achieve and sustain racial equity through proactive and preventative measures." See https://neaedjustice.org/wp-content/uploads/2018/11/Racial-Justice-in-Education.pdf and [Hi00].

9 https://genderedinnovations.stanford.edu/

10 https://www.gerd-model.com/

the initial motivation and planning to modelling, testing and implementation to deployment and enriches those phases through reflection aspects taken from gender research. The reflection aspects mirror key concepts such as power relations, values, benefits, relevance etc. in their relation to social inequality. These aspects are substantiated through a list of questions that deal with specific phases of IT development. The model also works with examples from IT research and development to illustrate the benefits gained by working with diversity in informatics aspects [DM18]. Beyond its application in informatics research and development, the GERD model is also useful for teaching informatics students sociotechnical systems design with a focus on gender equity and non-discrimination.

4 In lieu of conclusion: Integrating and caring for diversity in informatics

The motivation for this paper arose from the finding that despite a rich body of gender and diversity expertise focusing on STEM disciplines the effect of this knowledge on informatics is insufficient. In this final section I want to point out some of the obstacles and explore ideas for achieving a more sustainable integration.

Very broadly speaking, gender and diversity expertise suffers from a lack of structural integration in technical disciplines with informatics being no exception. Taking up the debates on the disciplinary foundation of informatics, I have pointed out the need to address social aspects within technical fields, and likewise I have stated how challenging this can be for people in informatics. Feminist philosophers of science have succinctly formulated that a positivist understanding of science, as it is traditionally common to the natural and technical sciences, feeds its validity precisely from a supposed independence from the social world [Ha86]. Therefore, understanding the relevance of intersectional gender research, rooted in the social sciences and the humanities, for all areas of research, development and education for informatics can be challenging. In addition, the complexity of the intersectional approach can be difficult to account for, especially since informatics relies on formalized, rule-oriented forms of knowledge.

Gender equity measures that focus on unequal participation in the technical field appear to be more widely accepted and implemented. In contrast, intersec-

tional gender research in regards to knowledge of informatics, methodology and design and development approaches is not explored sufficiently. I have shown that gender- and diversity-oriented IT design approaches exist, and awareness of the social impact of IT, for example towards bias in AI, continues to grow. However, giving this expertise an integrated, structural home in building curricula as well as the planning of technical departments is, apart from a few exceptions, largely missing. This is not just true for intersectional gender research but in general for considering social aspects as being of equal value as technological ones. Topics such as "informatics and society" or "ethics in computing" as part of informatics education are mostly realized in the form of electives and not considered foundational, although there is plenty of discussion on this need for integration [Co20; Qu06].

When it comes to working with diversity in informatics, a systemic approach covering all areas of informatics is crucial. I have formulated elsewhere that it is problematic to only raise diversity issues when explicitly dealing with gender imbalances or marginalized user groups [DD21]. Stanford University's above mentioned Gendered Innovations project developed a threefold approach: "fix the knowledge", "fix the institutions" and "fix the company" are named as important areas on where to work on with intersectional gender expertise in STEM, covering all areas.[11]

Steps towards an academic disciplinary culture that enables and promotes working with diversity in informatics would, not exhaustively, include the following: First, increasing awareness of the need for diversity-orientation and the benefits that come with it, is important. The digital transformation of almost all life domains has brought questions regarding the societal acceptance and individual user acceptance of IT systems to the fore. This helps a lot with raising awareness and also fosters sociotechnical, systemic perspectives on IT system design. Second, working at the intersection of the social sciences, the humanities and informatics requires space and resources for interdisciplinary exchange. This exchange should not only be realized through interdisciplinary research projects but also supported structurally. Furthermore, this exchange needs to be conceptually accounted for and the methodology for working between the social sciences and informatics must be strengthened. For this, Bhabha's concept of the "third space" and hybridity, which I have pointed out in the introduction, could be useful [Bh94]. Increasing awareness as well as providing space and resources could form the basis for jointly developed translational knowledge

11 See https://genderedinnovations.stanford.edu/what-is-gendered-innovations.html

at the interface of gender and diversity research and informatics. The "third space" would make methodologies that emerge through co-creation practices possible. This would challange epistemological hierarchies between social and technical fields. Moreover, knowledge, measures and guidelines that have been jointly created would find a stronger acceptance and hopefully be more readily implemented in informatics departments.

A further perspective I have suggested is to reconsider diversity awareness (and implementation) work in informatics through the lens of feminist ethics of care. In the introduction I pointed out that care is defined as "a species activity that includes everything that we do to maintain, continue and repair our 'world' so that we can live in it as well as possible" [TF90]. What is understood as living well and what is needed to achieve it depends on the context and is subject to change. In an informatics department caring may mean making an effort to understand the causes for lack of diversity in students enrolled and trying to "eliminate" causes for persisting inequalities. It could also mean learning to understand how social inequalities relate to one's own research. Through the lens of care, a sustainable integration of diversity expertise in informatics motivates questions such as: How do guidelines really become part of the disciplinary culture in informatics research, development and education – not just on paper but as a lived practice? Who cares for diversity issues and why? Who does the work? Who cares about the concepts used? Who cares about educating themselves and others about basic concepts such as diversity and intersectionality in relation to informatics? How can this caring for diversity work be supported structurally? Are resources, capacities and attention redistributed accordingly?

To conclude, working with diversity in informatics does not just require the respective expertise. It also requires structural support to sustainably cultivate diversity awareness. Furthermore, caring for diversity must be determined as a central objective. This includes to acknowledge, value and take on the actual work that comes with it.

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