EUROPEAN JOURNAL OF STEM EDUCATION

European Journal of STEM Education, 2022, 7(1), 12
ISSN: 2468-4368

lectito

How Diverse Is Diversity? An Exploration of References to Diversity in the Recent Literature in STEM Higher Education

Amber Bruijnzeel [1], Demet Yazilitas [1], Ionica Smeets [1], Pedro De Bruyckere [1, 2], Julia Cramer [1*]

[1] *Science Communication and Society, Leiden University, Leiden*, THE NETHERLANDS
[2] *Arteveldehogeschool University College of Applied Sciences*, BELGIUM

*__Corresponding Author:__ j.cramer@biology.leidenuniv.nl

Citation: Bruijnzeel, A., Yazilitas, D., Smeets, I., De Bruyckere, P. and Cramer, J. (2022). How Diverse Is Diversity? An Exploration of References to Diversity in the Recent Literature in STEM Higher Education. *European Journal of STEM Education*, 7(1), 12. https://doi.org/10.20897/ejsteme/12667

Published: November 24, 2022

ABSTRACT

Since STEM knowledge and skills are increasingly being sought after in our information and technology driven economies, it is pivotal that ideas and human resources that foster these economies also reflect the STEM population. Although it is evident from earlier research that specific demographics are clearly underrepresented, little is known about who constitutes as 'diverse', which makes it challenging to develop and assess effective policies aimed at increasing diversity in STEM. Through content analysis, we explore in recent STEM education literature, which groups of students and faculty are referenced in relation to diversity, i.e., groups that are underrepresented. The results reveal 180 uniquely defined references to underrepresented groups in STEM. Our main results show that across articles, the majority of the references to diversity are related to gender (69%), and a considerable portion of references (12%) can be classified under 'other unspecified minorities'. Consequently, the analyzed articles portray a narrow understanding of diversity, and a variety of groups remain unspecified when it comes to background characteristics. To change this, clear definitions of the target groups are necessary and more consensus among the research community about the justifications to include or exclude these groups is needed.

Keywords: diversity, STEM, higher education, policy, content analysis

THEORY AND INTRODUCTION

In recent decades the demand for Science, Technology, Engineering and Mathematics (STEM) students has been growing. In the USA, for example, it is estimated that in the next decade, the number of STEM jobs will grow by 8%, which is double the amount compared to non-STEM jobs (Zilberman and Ice, 2021) and overall employment in STEM occupations has grown approximately 79% between 1990 and 2018 (Funk and Parker, 2018). In the EU, there is evidence of skills shortages in STEM fields and demand is expected to grow, i.e., by 2025 some 7 million job openings are expected (Caprile, Palmén, Sanz and Dente, 2015).

Traditionally, efforts to increase the number of students in STEM have primarily been directed towards increasing the number of female students, since female students are long known to be underrepresented in these fields (Yazilitas, Svensson, De Vries and Saharso, 2013). More recently, attention and efforts have expanded from merely attracting more female students in STEM fields to having a more diverse STEM population all together (Benish, 2018).

The call for more diversity is not exclusive to STEM fields or education but is currently vocalized in various domains, including media, politics, management, and government. It fits a general trend that is characterized by

growing concerns over socioeconomic inequality between various groups in society, which has recently been fuelled due to the COVID-19 pandemic crises. An important way to counterbalance these inequalities and to create more equity and more equal opportunities is through education and career opportunities, i.e., the notion of education as the great equalizer as Horace Mann stated (see Bernardi and Ballerino, 2016). The need for more equity and more equal opportunities is particularly crucial in STEM fields since the availability of STEM knowledge, skills and human resources is becoming more and more indispensable in information and technology-driven economies (Atkinson and Mayo, 2010). The objective to have a more diverse STEM population and retain all talents in STEM follows naturally from this development. However, it is currently very unclear which groups are referred to when talking about diversity in STEM and what their main characteristics are.

The meaning of diversity varies between focus areas. Dependent on the needs within the field, the conceptualization of diversity differs. For example, in management research diversity variables can range from "highly job-related diversity", including educational and functional background to "less job-related diversity," such as age, sex, and other related demographic indicators. to measure the effects of diversity on team performance (Bell et al., 2011). The Interactional Model of Cultural Diversity (Cox Jr., 2013) describes that diversity directly effects organizational effectiveness.

Often, social processes such as similarity attraction (Harrison and Klein, 2007) are at the basis of the frameworks. The aforementioned authors define three diversity types: separation, variety, and disparity. However, demographic diversity, most often studied, can be conceptualized in all three types.

In educational research, especially in the US, college diversity experience is an issue of growing importance. There are several types of college diversity experience, such as structural diversity within the representation of students in a larger group, informal interactions with diverse peers and learning about diverse peers in a classroom context. Meta studies show that while diversity experiences are positively related to cognitive outcomes, but the effect varies depending on the type of diversity experience, cognitive outcomes, and study design (Bowman, 2010).

In this article, we explore the terminology that is used in reference to diversity in recent literature on STEM higher education as a first step to understanding what is meant by a more diverse STEM population. This is important because a clear understanding of the groups that fall under this definition will enable researchers to better design and assess the effectiveness of programs targeted at creating more diversity in STEM. Therefore, we focus specifically on diversity in STEM education in the context of higher education, including both students and faculty members. Higher education students are the main focus of this research for the reason that they represent the future generation of STEM employees. Faculty are included because they can serve as role models for students (Weber, 2011).

This research will help to discover which groups are most often referred to in relation to diversity in the recent research literature on increasing diversity in STEM higher education and what the implications are for future research.

METHODOLOGY

We conducted an exploratory study on academic literature, combining quantitative and qualitative content analysis in which we assessed which groups are most often referred to in recent research literature on increasing diversity in STEM fields, in the context of higher education. Various steps were followed to identify which articles should be included in the research.

The first step involved the choice of a primary database and defining search criteria. The Web of Science core collection was used as our primary database since it is one of the largest databases and contains a wide variety of articles that are relevant to our topic of interest. The search criteria (in March 2021) were as follows: (a) the article had to mention 'STEM', 'Science', 'Technology', 'Engineering', 'Mathematics', 'higher education' and 'diversity' in their abstract and/or title and (b) the article had to be peer-reviewed. This first step yielded a total of 51 articles ranging from the year 2009 to 2020.

The second step involved reading the abstract and the introduction of the papers. An article was included when its main topic was on increasing diversity in STEM higher education, including faculty.

The third step involved classifying the articles based on citation, as a measure of impact on the field, starting with the articles that had the highest citation score. Articles that were cited ten times or less, were excluded from this research as they were considered to have low impact within the field of STEM research. This third step resulted in 10 articles, with citations ranging from 62 times (highest) to being cited 12 times (lowest) (**Appendix B**).

The fourth step was to open code the abstract, introduction, theoretical framework and discussion using *Atlas.ti cloud*. Initially, all groups of people that were mentioned in the context of diversity and STEM higher education were assigned an individual label, including groups that were almost identical. For example, the groups 'underrepresented minorities' and 'underrepresented groups' were coded separately even though they are quite similar. The inclusion of these groups was based on our interpretation of the context in which a group was

mentioned. In the case of, for example, "... *increasing and retaining the number of female students enrolled in STEM disciplines can help to alleviate part of the challenges faced by women in STEM fields.*" (Botella, Rueda, López-Iñesta and Marzal, 2019, p. 1) both "female students" and "women" were included since the focus is on the representation of these groups in STEM disciplines. This prevents terms such as 'women's representation' to be included in the analysis since, within the previously mentioned context, they do not refer to women as a group but to the representation of women. This yielded a total of 180 individually labelled groups (**Appendix A**).

Step five consisted of checking for transparency of the codes by including a second coder to code two articles independently from the first coder and to discuss any inconsistencies. Agreeance was approximately 83%. In this step codes that were formulated slightly different were merged together and codes that were agreed on being out of context were excluded.

The final and sixth step, was to further categorize the groups. For example, the groups labelled as 'women students' and 'young women' were both classified as *women*, whereas 'female students' and 'female professionals' were classified as *females*. Both *women* and *females* were then classified under gender. All references were also counted. The subcategories and the distribution of references will be discussed in more detail in our results below.

RESULTS

Table 1 shows an overview of the titles included in the research, the target group of the paper, the year of publication (YOP), and number of citations of the article by March 2021. References to the included articles are included in **Appendix B**. The target group is the main group of interest that is referred to in relation to increasing diversity in STEM according to the article. When reviewing the target groups and titles, it stands out that 7 out of 10 ten articles are aimed towards including more women or females in STEM fields and higher education (**Table 1**).

Table 1. Overview of the articles included in the analysis ranked on times cited

No	Title	Target group	YOP	Cited
1	Counterspaces for women of color in STEM higher education: Marginal and central spaces for persistence and success	Women of colour students	2017	62
2	Female peers in small work groups enhance women's motivation, verbal participation, and career aspirations in engineering	Undergraduate female students	2015	61
3	Enhancing diversity in undergraduate science: Self-efficacy drives performance gains with active learning	Higher education underrepresented minority students	2017	42
4	Now hiring! Empirically testing a three-step intervention to increase faculty gender diversity in STEM	Women	2015	42
5	Diverse faculty in STEM fields: Attitudes, performance, and fair treatment	Women and ethnic or racial minorities	2009	31
6	Toward inclusive STEM classrooms: What personal role do faculty play?	Diverse (STEM) students	2016	23
7	The gender gap in high school physics: Considering the context of local communities	Female high school students or women	2014	14
8	Gender diversity in STEM disciplines: A multiple factor problem	Female students or women	2019	15
9	Gender diversity strategy in academic departments exploring organizational determinants	Women	2014	13
10	The equity ethic–Black and Latinx college students reengineering their STEM careers toward justice	Black and Latin students	2017	12

Distribution of the Subcategories

Four subcategories were distinguished: 1) gender, 2) ethnicity and/or race, 3) a combination of ethnicity and/or race and gender and, 4) other unspecified minorities. The first subcategory includes references that solely refer to a group indicated by gender, including 'women' and 'females' as one of the most occurring references. The second subcategory includes references to groups indicated by ethnicity and/or race. Frequently occurring groups include 'ethnic or racial groups', 'Black', 'Latinx'–a term which is used to cover both Latina's and Latino's -, and 'people of colour'. The third subcategory includes references to groups indicated by ethnicity and/or race and gender and includes references such as 'women of colour', women from ethnically or racial groups specified as 'black women', 'white women', and 'African American women'. The fourth subcategory includes references to groups that are indicated by general terms of underrepresentation but are not specified in terms of gender, race and/or ethnicity. Some examples of the most occurring references here are: 'underrepresented minorities', 'underrepresented groups', 'underrepresented students', and 'marginalized groups'.

Looking at the distribution of the subcategories, it is clear that gender is by far the most referenced subcategory (**Table 2**), with almost half of the total number of references across the sample. This is even more so when we also take into account the subcategory ethnicity and/or race and gender, together making up almost 70% of all references that can be linked to gender.

Table 2. Distribution of the subcategories across ten articles

Group	Total times mentioned	Percentage (%)
Gender	573	49
Ethnicity or race	223	19
Ethnicity or race, and gender	232	20
Unspecified minorities	146	12
Total	**1,174**	**100**

Distribution of the subcategories per article

Regarding the distribution of the subcategories per article, it is evident that gender is most referred to (**Figure 1**). Despite article 1 containing some more specific references to ethnicity and/or race in combination with gender, it still relates to gender as well. This is not a surprising finding since most articles are targeted towards increasing the number of women in STEM higher education.

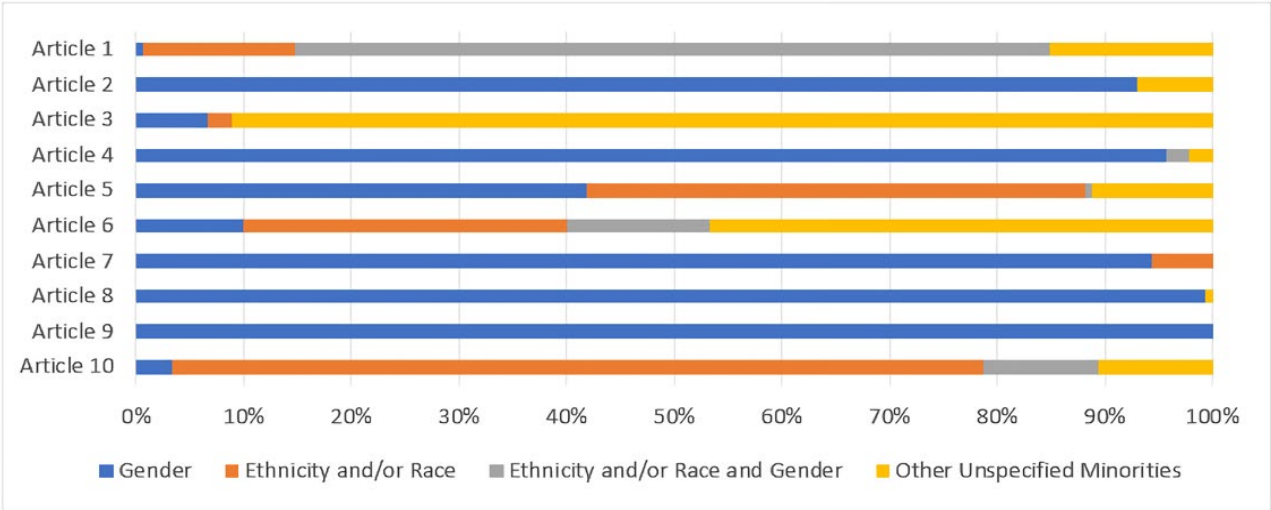

Figure 1. Distribution of the four subcategories per article (the distribution is a relative distribution; total number of references vary between articles)

Distributions differ when considering the articles that are not directed towards women in STEM specifically, including articles 3, 6 and 10. Article 3 mainly contain references to Ethnicity and/or Race while article 10 refers mainly to other unspecified minorities, whereas article 6 shows a more equal distribution of group references. In the next paragraphs, we will elaborate on the smaller categories that fall under the four subcategories (**Table 2**).

Gender

When zooming in on the subcategories and the distribution of particular groups within each subcategory, there are clear trends as well. Starting with the distribution of groups within the subcategory gender, by far the most often referred group within this subcategory is 'women', which corresponds with 74% of the references related to gender. 'Females' make up 17%, 'women or female faculty' 5% and 'girls' correspond to 4% of the references (**Figure 2**).

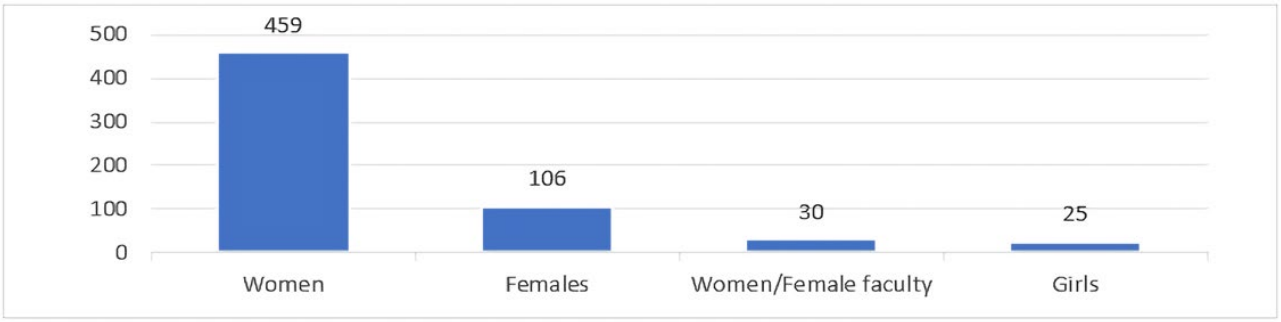

Figure 2. Distribution of groups within the category gender n=620

Ethnicity and/or race

The distribution of references within the subcategory ethnicity and/or race is less skewed than in the case of gender (**Figure 3**). Specific groups that are mentioned most frequent include' ethnic or racial groups' (29%), 'Black' (22%) and 'Latinx' (17%)–where Latinx comprises both Latina and Latino people. 'Other groups' make up for 12% of the references. The latter includes references to 'African American', 'Hispanic', 'Mexican American' and 'Hispanic American', which are all mentioned no more than twice in the whole sample.

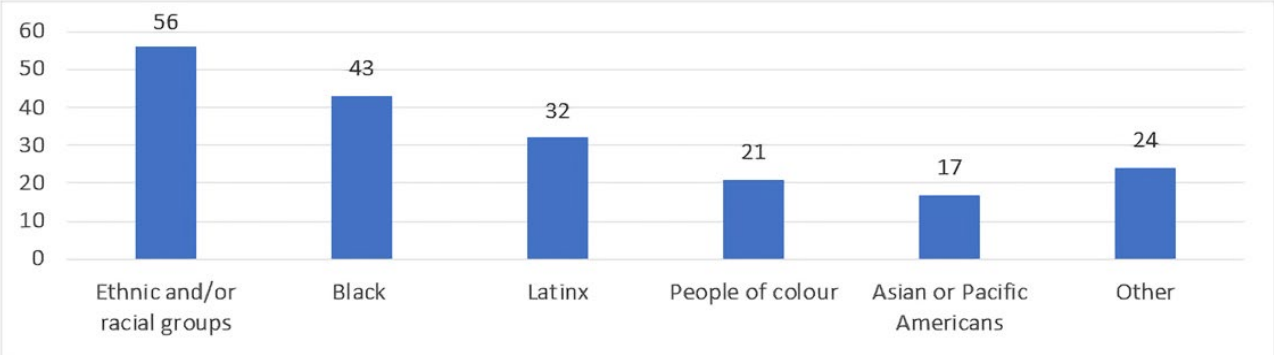

Figure 3. Distribution of groups within the category ethnicity or race n=193

Ethnicity and/or race and gender

In relation to specific groups within the subcategory ethnicity and/or race and gender, 'women of colour' is the vast majority with 93% of the references (**Figure 4**). This particular group is composed of various similar references, including 'women of colour', 'coloured women' and 'women of colour students'. Besides women of colour, two other groups were mentioned in this context, as can be seen in **Figure 4**, although their share is limited to 7% of the references within this subcategory. The category' other ethnicity or race women' consists of a wide variety of references that are mostly mentioned only once within the whole sample, such as 'African American women', 'Multicultural women', 'white females' and 'women from multiple racial or ethnic backgrounds.'

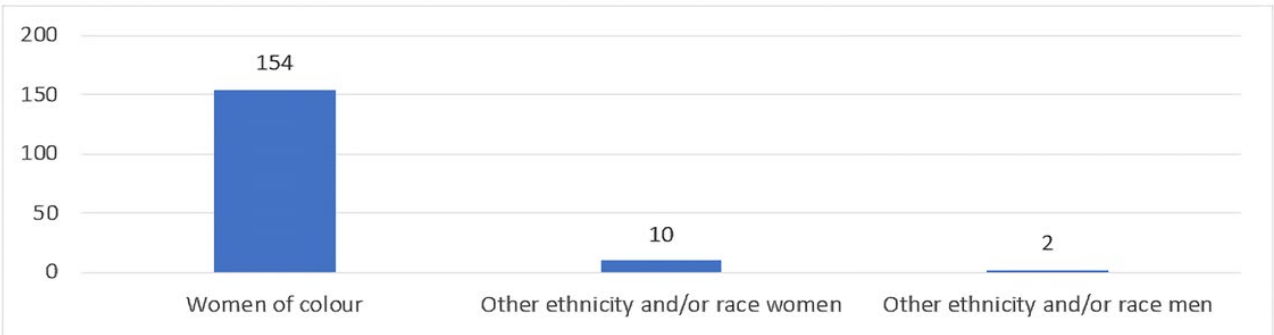

Figure 4. Distribution of groups within the category ethnicity and/or race and gender n=166

Other unspecified minorities

The most frequently mentioned group within the category of other unspecified minorities is 'underrepresented minorities' (hereafter 'URM'), representing 60% of all the references (**Figure 5**).

Figure 5. Distribution of groups within the category other unspecified minorities n=120

URM itself is comprised of specific references such as 'underrepresented minority students', 'underrepresented minority groups' and 'minorities.' The group' underrepresented groups or students' is the second most frequently referred, and only group next to URM, representing 40% of all references within the subcategory. The group is comprised of a wide variety of references, including 'marginalized groups', 'underserved groups', 'non-dominant groups', 'non-traditional groups', 'students at risk', and 'low socioeconomic status students', each of which is mentioned two times or less across articles.

DISCUSSION AND CONCLUSION

The underrepresentation of female students in STEM has been an important theme in the research on diversity in STEM in the last ten years (Li et al., 2020). Recently there has been a shift towards promoting more diversity in the STEM population in more general terms. While the meaning of diversity has been studied in other fields such as management, it has largely been left unclear which groups are and should be targeted in promoting more diversity in STEM education. To get a better understanding of which groups are currently targeted, we performed content analysis among recent literature within the topic of diversity in STEM higher education.

First of all, our results demonstrate that 'women' are by far the most often mentioned group across articles and that in our sample the overwhelming majority of references to diversity in STEM higher education can be linked to gender. This is followed by an intersection of ethnicity and/or race, an intersection of ethnicity and/or race and gender and a category that we refer to as unspecified. The primary focus on gender is in line with previous literature, which has mainly focused on increasing female participation in STEM (Caprile et al., 2015; Yazilitas et al., 2013). At the same time, the finding is somewhat surprising considering recent efforts and calls to have a more diverse and inclusive STEM population, i.e., one that is a better reflection of the various groups of people in modern-day, Western societies (Bernish, 2018).

Our results also show that there is a lot of variety, other than the ones that are linked to gender, used to refer to underrepresented groups in STEM higher education. The previous is evinced by a large number of unique references (180) in the sample we explored and the wide variety of groups that they comprised. This existence of so many references can be considered as a lack of specificity. The majority of articles in our sample did not further specify their target group. On the one hand, some did specify by referring to women's ethnicity or race as in the case of 'black women' or 'women of colour'. Although more specific, the question remains, which group of women is targeted. On the other hand, more general references were used, such as 'underrepresented groups' or 'underserved minorities', without further explaining or defining factors such as gender, race, ethnicity, or socioeconomic status.

Finally, our study reveals some important discrepancies in the use of references across our sample, which suggest that researchers–besides seemingly having a narrow practical definition of diversity–differ widely in their understanding of the concept of diversity. For example, some articles in our sample refer to 'white women' being underrepresented in STEM which is incongruent to the finding that 'black women' are one of the main underrepresented groups. In the case of white women, one can argue that the reference is too general, and that the specific context matters a great deal in considering the person or group to belong either to the under- or overrepresented group.

The lack of agreement or consensus among researchers, even about quite specific ethnic groups, combined with the lack of specificity mentioned before and the overwhelming focus on gender, prevents real progress in this research field.

Limitations

Because of the novel character of this research, some limitations arise. For the data collection, due to time limitations, we solely used Web of Science and selected the ten most cited articles for a first exploration. Ideally, multiple databases should be used to get a wider scope on what literature is available within the context of increasing diversity in the field of STEM higher education. Furthermore, we have chosen to select articles based on number of citations as a measure of impact on the field. However, it would be interesting to see if there is more consensus and a broader scope of diversity in newer articles. Furthermore, by selecting on number of citations, we might have excluded publications from minority academic institutions, overrepresenting the scope of more Western oriented academics. Finally, by including 'STEM' and all terms' Science' 'Technology', 'Engineering' and 'Mathematics' as search terms for the abstract, we might have missed relevant articles that chose not to use the abbreviation, or the terms written out.

This research also assessed the terms that were mentioned across articles quantitatively. This does not always give a good indication of what groups are mentioned, since the data was heavily skewed across articles. We tried to counterbalance this by using relative scales, but it is difficult to generalize these results as they give a limited view of how references are used in literature.

Finally, although we are aware of a broad availability of frameworks on diversity (Cox Jr., 2013; Harrison and Klein, 2007; Bowman, 2010) we did not build upon an existing theoretical framework. This work is a first exploration of existing research and references in STEM education with respect to (demographical) diversity. In further research we highly recommend to research connections between these terms and, for example, diversity experience.

Recommendations

More cohesion and specificity in terminology is needed in future research to effectively create policies to increase diversity in STEM higher education. Defining clear target groups are in our opinion the biggest challenge in effectively addressing the lack of diversity in STEM higher education and assessing future policies. In order to change this, several strategies can be followed. These should in our opinion at least include the following four components.

Firstly, a clear definition of the target groups and the main criteria of selection on which these target groups have or have not been included in the sample should be included in the introduction.

Secondly, target groups differ per country and over time. Taking into account these country differences and specific context is pivotal in better understanding the current state of affairs in relation to the representation of various groups within the STEM population and changing these in another direction.

Thirdly, it would benefit the research field if the research objective was more linked to earlier policy initiatives, and for example, include a (short) overview of (earlier) policy efforts in order to better understand the current or future situation in relation to increasing diversity in STEM. Too often, the research objective, i.e., increasing diversity in STEM is unlinked to earlier policy initiatives, resulting in misunderstanding or misevaluation of the effects of current policies.

ACKNOWLEDGEMENT

This research project is fully funded by the NWO grants within the Dutch Research Agenda [Dossier number: 400.17.608].

REFERENCES

Atkinson, R. D. and Mayo, M. J. (2010). Refueling the US innovation economy: Fresh approaches to science, technology, engineering and mathematics (STEM) education. *The Information Technology & Innovation Foundation, Forthcoming*. Available at: https://files.eric.ed.gov/fulltext/ED521735.pdf

Bell, S. T., Villado, A. J., Lukasik, M. A., Belau, L. and Briggs, A. L. (2011). Getting specific about demographic diversity variable and team performance relationships: A meta-analysis. *Journal of Management*, 37(3), 709-743. https://doi.org/10.1177/0149206310365001

Benish, S. (2018). Meeting STEM workforce demands by diversifying STEM. *Journal of Science Policy & Governance*, 13(1), 1-6.

Bernardi, F. and Ballarino, G. (2016). Education as the great eequalizer: A theoretical framework. In F. Bernardi and G. Ballarino (eds), *Education, occupation and social origin. A comparative analysis of the transmission of socio-economic inequalities* (pp. 1-19). Cheltenham Glos: Edward Elgar Publishing. https://doi.org/10.4337/9781785360459.00006

Botella, C., Rueda, S., López-Iñesta, E. and Marzal, P. (2019). Gender diversity in STEM disciplines: A multiple factor problem. *Entropy*, 21(1), 30. https://doi.org/10.3390/e21010030

Bowman, N. A. (2010). College diversity experiences and cognitive development: A meta-analysis. *Review of Educational Research*, 80(1), 4-33. https://doi.org/10.3102/0034654309352495

Caprile, M., Palmén, R., Sanz, P. and Dente, G. (2015). Encouraging STEM studies labourmarket situation and comparison of practices targeted at young people in different member states. *European Parliament, Directorate General For Internal Policy, Policy Department A, Economic and Scientific Policy*. Available at: http://www.europarl.europa.eu/studies

Cox Jr., T. (2013). Interactional model of cultural diversity. In E. Kessler (ed.), *Encyclopedia of management theory* (pp. 390-394). SAGE. https://doi.org/10.4135/9781452276090.n136

Funk, C. and Parker, K. (2018). Women and men in STEM often at odds over workplace equity. *Pew Research Center*. Available at: http://hdl.handle.net/10919/92671

Harrison, D. A. and Klein, K. J. (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

Li, Y., Wang, K., Xiao, Y. and Froyd, J. E. (2020). Research and trends in STEM education: A systematic review of journal publications. *International Journal of STEM Education*, 7, 11. https://doi.org/10.1186/s40594-020-00207-6

Weber, K. (2011). Role models and informal STEM-related activities positively impactfemale interest in STEM. *Technology and Engineering Teacher*, 71(3), 18.

Yazilitas, D., Svensson, J., de Vries, G. and Saharso, S. (2013). Gendered study choice: Aliterature review. A review of theory and research into the unequal representation of male and female students in mathematics, science, and technology. *Educational Research and Evaluation*, 19(6), 525-545. https://doi.org/10.1080/13803611.2013.803931

Zilberman, A. and Ice, L. (2021). Why computer occupations are behind strong STEM employment growth in the 2019-29 decade. *U.S. Bureau of Statistics*. Available at: https://www.bls.gov/opub/btn/volume-10/why-computer-occupations-are-behind-strong-stem-employment-growth.htm

APPENDIX A

Table A1. Colours are solely for the purpose of making clear where the subthemes start and end

Subcategories	Codes
I. Ethnicity and/or race	African American
	African American professionals
	Asian
	Asian minorities
	Asian or Pacific American
	Asian or Pacific American faculty members
	Asian American
	Students who identify as African-American, Latino or Latina, Asian-American, White
	Mexican
	Ethnically diverse group(s)
	Ethnic minority group
	Ethnic minority students
	Demographic groups
	Black students (& students who are black)
	Latino families
	Latino men
	Latino STEM degree holders
	Latina women
	Latinx
	Latinx college students
	Latinx individuals
	Latinx students
	Latinx undergraduate students
	Latinx workers
	Marginalized Latinx students
	Latina or Latino students
	Black undergraduate students
	Black workers
	Black
	Black college students
	Black individuals
	Black scientists
	Faculty of colour
	Non-white
	Racial groups
	Black (PhD) students
	Black Americans
	Black families
	Black graduates
	Black peers
	Black people
	Black STEM degree holders
	Black STEM majors
	Hispanic Americans
	Hispanic STEM majors
	Students of colour
	Professionals of colour
	People of colour
	Marginalized black students
	Non-white students
	African American or Black
	Ethnic or racial group
	Ethnic or racial minorities
	Ethnic or racial minority groups

Table A1 (Continued).

Subcategories	Codes
I. Ethnicity and/or race	Groups that are racially or ethnically heterogeneous
	Hispanic
	Hispanic or Latino or Mexican American
	Latina or Latino students
	Latino families
	Latino men
	Latino STEM degree holders
	Latino or Latina
	Latinx
	Latinx college students
	Latinx graduates
	Latinx individuals
	Latinx peers
	Latinx students
	Latinx undergraduate students
	Latinx workers
	Marginalized Latinx students
	Minority undergraduates referring to Black, Latinx, American Indian, Asian
	Non-Asian racial or ethnic minority groups
	Other racial or ethnic groups
	Other racial or ethnic groups (outside of Black PhD)
	Racial or ethnic minority
	Racial or ethnic minority faculty
	Racial or ethnic minority group
	Racially and ethnically diverse groups
	Racially or ethnically underrepresented groups
	Racially or ethnically underrepresented students
	Students from racially or ethnically underrepresented groups
	Underrepresented racial or ethnic groups
II. Gender	Faculty women
	Female academics
	Female chairs
	Female department chairs
	Female experts
	Female faculty
	Female faculty members
	Female high school graduates
	Female high school students
	Female leaders
	Female managers
	Female MBA students
	Female peers
	Female STEM professionals
	Female students
	Females
	Graduated women
	Girls
	Graduated female students
	High school girls
	Highly or moderately qualified women
	Same-sex experts
	Same-sex peers
	Women
	Women academics
	Women administrators

Table A1 (Continued).

Subcategories	Codes
II. Gender	Women advanced college career
	Women chairs
	Women faculty
	Women students
	Young women
III. Ethnicity and/or race and gender	Women of colour who self-identify as Asian American, Black, Latina or Latino, Native American, Mixed race or ethnicity
	Women of colour referring to African American, Asian American, Latina, Native American and Pacific Islander
	Women of colour
	Women of colour in higher education as students
	Women of colour students
	Black women
	Black men
	White women
	White females
	Underrepresented students particularly women of colour
	Latino
	Multicultural undergraduate women
	Non-traditional groups including mixed race or ethnicity, Women, Racially or ethnically underrepresented students, women of colour
	Often Marginalized groups referring to Women, Ethnical or racial minorities
	Women from historically underrepresented racial or ethnic group
	Women of colour from varying racial or ethnic backgrounds
	Women of colour who self-identify as Asian American, Black, Latina or Latino, Native American, Mixed race or ethnicity
	Women from multiple racial or ethnic groups
IV. Other unspecified minorities	University students from low-socioeconomic backgrounds
	Historically underrepresented groups
	Historically underrepresented minority (URM) students
	Historically underrepresented students
	Historically underserved groups
	Historically disadvantaged groups (referring to women and ethnic minorities)
	Marginalized groups
	Marginalized groups that do not reflect the gender, race, or ethnicity conventionally associated with STEM mainstream success
	Marginalized group members
	Marginalized groups
	Marginalized higher education students
	Marginalized individuals
	Marginalized participants
	Often Marginalized groups
	Other Marginalized groups
	Traditionally Marginalized groups
	Underrepresented minorities referring to (PhD) students, doctoral and postdoc
	Groups that are more traditionally Marginalized in American culture
	Marginalized university faculty
	Traditionally marginalized students
	Underrepresented (minority) groups
	Members of other underrepresented groups
	Members of underrepresented groups
	Minority students
	Underrepresented groups
	Underrepresented minority (URM) students
	Underrepresented minority groups
	Underrepresented minority postdocs
	Underrepresented minority students
	Underrepresented minority (STEM) students (mostly referring to Black & Latin students)
	Underrepresented people

Table A1 (Continued).

Subcategories	Codes
IV. Other unspecified minorities	Underrepresented students
	Underrepresented or disadvantaged groups
	Other underrepresented groups
	Other underrepresented students
	Underrepresented minority scientists
	Model minorities
	Underrepresented minority individuals
	Negatively stereotyped group (not sure)
	Stereotyped group (not sure)
	Students at risk
	Students from historically underrepresented backgrounds
	Underserved groups
	Other non-dominant groups
	Diverse students
	Individuals who are demographically different
	Students over age 25
	Young students

APPENDIX B: REFERENCES OF DATASET

Ballen, C. J., Wieman, C., Salehi, S., Searle, J. B. and Zamudio, K. R. (2017). Enhancing diversity in undergraduate science: Self-efficacy drives performance gains with active learning. *CBE–Life Sciences Education*, 16(4), ar56. https://doi.org/10.1187/cbe.16-12-0344

Blackwell, L. V., Snyder, L. A. and Mavriplis, C. (2009). Diverse faculty in STEM fields: Attitudes, performance, and fair treatment. *Journal of Diversity in Higher Education*, 2(4), 195-205. https://doi.org/10.1037/a0016974

Botella, C., Rueda, S., López-Iñesta, E. and Marzal, P. (2019). Gender diversity in STEM disciplines: A multiple factor problem. *Entropy*, 21(1), 30. https://doi.org/10.3390/e21010030

Dasgupta, N., Scircle, M. M. and Hunsinger, M. (2015). Female peers in small work groups enhance women's motivation, verbal participation, and career aspirations in engineering. *Proceedings of the National Academy of Sciences*, 112(16), 4988-4993. https://doi.org/10.1073/pnas.1422822112

Killpack, T. L. and Melón, L. C. (2016). Toward inclusive STEM classrooms: What personal role do faculty play? *CBE–Life Sciences Education*, 15(3), es3. https://doi.org/10.1187/cbe.16-01-0020

McGee, E. and Bentley, L. (2017). The equity ethic: Black and Latinx college students reengineering their STEM careers toward justice. *American Journal of Education*, 124(1), 1-36. https://doi.org/10.1086/693954

Ong, M., Smith, J. M. and Ko, L. T. (2018). Counterspaces for women of color in STEM higher education: Marginal and central spaces for persistence and success. *Journal of Research in Science Teaching*, 55(2), 206-245. https://doi.org/10.1002/tea.21417

Riegle-Crumb, C. and Moore, C. (2014). The gender gap in high school physics: Considering the context of local communities. *Social Science Quarterly*, 95(1), 253-268. https://doi.org/10.1111/ssqu.12022

Smith, J. L., Handley, I. M., Zale, A. V., Rushing, S. and Potvin, M. A. (2015). Now hiring! Empirically testing a three-step intervention to increase faculty gender diversity in STEM. *BioScience*, 65(11), 1084-1087. https://doi.org/10.1093/biosci/biv138

Su, X., Johnson, J. and Bozeman, B. (2015). Gender diversity strategy in academic departments: Exploring organizational determinants. *Higher Education*, 69(5), 839-858. https://doi.org/10.1007/s10734-014-9808-z

