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"Science is ~~not~~ for me"

Finding ways to encourage Dutch children from minority backgrounds in their identification with science

Abstract

Current research in the Netherlands on diversity in STEM (science, technology, engineering, mathematics) and projects that aim to diversify STEM are mainly focused on girls/women as a demographic group. Girls and children from ethnic minority backgrounds and/or lower socioeconomic status tend to steer away from STEM. This is a problem, because there is a demand for professionals in STEM, the Netherlands is moving towards a cultural heterogeneous society and racial and gender disparities in STEM are pressing concerns. These circumstances form both an economical problem and are a matter of social equality and inclusivity. Therefore, an intersectional approach to Dutch research and projects on diversity in STEM is urgently required. In this research proposal, I shall explain how my research will draw on a diverse landscape of studies on intersectionality, science-identity, and the potential influence of media. I shall combine documentary research, interviews and survey questionnaires to develop a new media-based project to eventually find ways in which we can encourage 13- to 16-year-old children from minority backgrounds in the Netherlands to actively identify with science.

Introduction

"Science is not for me"

These are the words we often hear from children, even though they are interested in and capable of science (Archer, Dewitt, & Osborne, 2015; Archer et al., 2013; Dewitt, Archer, & Moote, 2018). Especially among children from an ethnic minority background and/or lower socioeconomic status, these thoughts are present and tend to steer them away from science (Archer et al., 2015). The 'science is not for me' thought illustrates a persistent problem in the field of science, technology, engineering and mathematics (STEM), namely a lack of diversity and inclusivity (National Science Foundation, 2017). In this project, I intend to research the current state of affairs in the Netherlands and to find ways in which we can enable children from a minority background to more readily identify themselves with science.

STEM is in need of a more diverse group of professionals

The aforementioned lack of inclusivity and diversity is a problem because of a number of reasons. First, there is a demand for STEM professionals in Europe and the United States, but the number of well-trained STEM professionals falls well short (Caprile, Palmén, Sanz, & Dente, 2015; President's Council of Advisors on Science and Technology, 2012). Targeting specific and usually neglected groups of children can help increase the number of available STEM professionals in the future. Furthermore, Hunt, Layton and Prince (2015) show that culturally diverse teams enhance creative performance, make better decisions and perform better financially than teams that represent fewer different cultural backgrounds. Simultaneously, racial and gender disparities in STEM occupations are pressing concerns. Ethnic minorities are less likely to work in STEM professions. In the United States, only 5% of those occupations are represented by Black people and 6% by Hispanic people, and overall 30% are represented by women (National Science Foundation, 2017).

People with non-Western migrations backgrounds continue to comprise a larger proportion of the Dutch population. The population is thus shifting in a culturally heterogeneous direction, with over 2 million inhabitants, out of 17 million total, with a non-Western migration background in 2017, compared to less than 0.5 million in 1980 (CBS StatLine, 2018). It is thus imperative that efforts are made to increase the participation of these minorities in STEM fields, especially since this will result in more qualified STEM professionals to fill the current gap (Stets, Brenner, Burke, & Serpe, 2017).

To be able to achieve this, the current situation in high schools has to be reviewed. During high school the most important choices regarding a possible career in STEM are made, and these children are the potential STEM professionals of the future. Unfortunately, numbers are currently unavailable on the distribution of children with or without a non-Western migration background and the study programs they choose in high school. However, these numbers are available for the distribution between girls and boys, which show how gender disparities still exist. VHTO, the Dutch bureau of expertise in girls/women and beta/technology, shows that in the school year 2016 – 2017, in VMBO (preparatory middle-level vocational education), 4% of girls and 32% of boys choose technology as their study program; in HAVO (higher general continued education), 10% of girls

and 27% of boys choose Nature & Technology as their study program; for VWO (preuniversity secondary education) these numbers are 29% and 45% respectively (VHTO Cijfers havo/vwo, 2018; VHTO Cijfers vmbo, 2018).

Everyone should be able and feel welcome to participate in STEM if they want to, but, as is well-documented in related literature I shall discuss below, this is currently not the case (Alegria & Branch, 2015; Archer et al., 2015; Archer et al., 2013). We urgently need to address issues related to diversity and inclusion, and we need to find ways to diversify the image of science and the ideas of who can do science or have a career in STEM. To conclude: the disparities in STEM are both an economical problem and a matter of social equality and inclusivity.

A mismatch in science identity

To further illustrate the problem, I shall draw from researches in which intersectionality theory is an important factor. Introduced by Kimberlé Crenshaw in 1989, intersectionality has swiftly been established as a field of study within academia (Collins, 2015). Collins defines intersectionality as follows: "The term intersectionality references the critical insight that race, class, gender, sexuality, ethnicity, nation, ability, and age operate not as unitary, mutually exclusive entities, but as reciprocally constructing phenomena that in turn shape complex social inequalities" (Collins, 2015, pp. 1).

Multiple studies from Archer et. al and Dewitt et al. draw on survey data and interviews from the ASPIRES project, a five-year longitudinal study from a large student cohort of 10-14-year-old children in England, which explores the children's science and career aspirations. The studies discuss why, even from a young age, many girls and Black children see a career in science as 'not for me' (Dewitt et al., 2018; Archer et al., 2015; Archer et al., 2013). Interviews with Black students and their parents evinced that certain students showed great interest in science, yet were less likely to express science or science-related aspirations than their White and Asian peers (Archer et al., 2015). In other words, an interest in science does not always translate into concrete scientific aspirations. These and other studies that draw on the same survey data suggest that the image girls have of themselves (for example: feminine, girly, caring) does not conform with that of a scientist (for example: nerdy, geeky, clever). Science careers, in short, are seen more as 'masculine' (Archer et al., 2013). Moreover, Archer, DeWitt and Wong (2014) found that children aged 12/13 who come from more privileged backgrounds, stated in this study as those with higher cultural capital ("based on parental university attendance, leaving school before 16, number of books in the home and visits to museums" (pp. 61)) were more likely to aspire to professional careers, particularly in science and medicine. Intersecting inequalities of ethnicity and social class, combined with gendered discourses of masculinity and femininity complement each other, increasing the 'science is not for me' feeling. As Archer et al. (2013) state: "we suggest that those girls and boys who feel excluded from high academic achievement will learn from an early age that science aspirations are 'not for me', even if they otherwise enjoy science in and out of school" (pp. 187).

Johnson, Brown, Carlone and Cuevas (2011) interviewed three women of color from the United States who do have a career in science. These interviews make clear how important finding a project that suits specific individual needs can be for the development of a person's science identity and

aspirations. All three women found refuge in educational enrichment science programs when they most needed it. For two of these women these programs were a means of escaping violent surroundings fed by cultural differences in their schools or place of residence, where they did not have a chance to develop their science-identity. For example, one woman tells about her first experiences with science as a girl, when she joined a special out of school project called MESA (Minorities in Engineering and Math and Science). This program, as well as other programs, gave these women the chance to develop their science identity and, at least in part, ensured they entered STEM professions. Johnson et al. (2011) also discuss and show the importance of an intersectional approach, which enabled the researchers to connect the dots in the lives of these three women.

The aforementioned studies are examples that show how developing a science identity, the ability to think of oneself as a scientist, is important for the development of scientific aspirations (Stets et al., 2017). Quantitative research shows that science identity indeed positively impacts the likelihood of entering a science occupation (Stets et al., 2017). The researchers draw from an eight year-longitudinal panel study in the United States that followed underrepresented college students in STEM-fields, with a final sample consisting of 966 participants. The researchers looked at the role that several factors, including having a strong science identity, have played in the decision of minority students to enter a science occupation after graduating. They conclude that their study shows that: "the identity process is the primary mechanism through which minority students choose a science occupation" (Stets et al., 2017, pp. 12).

The studies I discussed in the previous paragraphs illustrate the importance of the intersection of ethnicity, gender, and social class in researching inequality and inclusivity in STEM. In spite of major differences between American, English and Dutch culture and history, the studies illustrate the need and the potential of combining quantitative and qualitative research whilst using an intersectional approach. I intend to use the same approach in my research, which will be focuses on the Netherlands, as well.

The Netherlands scores low when it comes to equality in the field of STEM and high in gender-science stereotypes, which are associations that connect science with men more than women (Miller, Eagly, & Linn, 2015). Miller et al. (2015) found that male scientists outnumber female scientists nearly four to one in employment and education enrollment. Moreover, the study found that the Netherlands scores highest out of 66 countries in gender-science stereotypes. Current research in the Netherlands on diversity in STEM and projects that aim to diversify STEM are highly focused on girls/women as a demographic group. Even though the Netherlands is moving towards a more heterogeneous society, cultural and ethnic diversity have not been given a priority in the current field of research and projects on diversifying STEM. For example, VHTO, the Dutch bureau of expertise in girls/women and beta/technology, examines gender diversity and initiates projects focused on gender diversity. One of those initiatives is girlsday, an annual event full of activities where STEM companies open up for teenage girls (https://www.vhto.nl/projecten/girlsday/over-girlsday/). Another project is the website Ditdoeik.nl (roughly translated to 'this is what I do'), which contains pictures, videos and stories of women and men in STEM. While people of color are certainly present in these and other projects of VHTO, ethnic differences are not specifically mentioned in the information on the VHTO-website (https://www.vhto.nl/) or in their research. Focusing on girls might help in terms of gender equality, but without including

demographic indicators such as socioeconomic status and ethnicity, multiple groups of less privileged children will remain neglected. An intersectional approach to Dutch research and projects on diversity in STEM is therefore urgently required.

To conclude: there exists a gap in the current body of research on diversity and inclusivity in STEM in the Netherlands. The overall aim of the proposed project is to find ways in which we can support Dutch children from a minority background in identifying with science.

Aim and research questions

To narrow down the topics I have discussed so far and get to my research plan, first I will explain why I chose to focus this project on a specific age group and on a particular method of approaching this age group.

I shall focus on the specific age group of 13 to 16-year-old children for two reasons. First, children in the Netherlands have to choose their exam courses when they are in year 2 (for VMBO) or 3 (for HAVO and VWO) of the Dutch secondary educational system (further referred to as 'high school'), when they are aged 13 to 16. All three streams offer programs focused on beta topics such as mathematics, physics, and chemistry. The moment children choose their study program is the first official opportunity for them to steer away from or move towards a STEM study after graduating. Therefore, a more inclusive field of STEM starts at this particular moment. Second, research shows that this age group is highly sensitive to external influences, for example stereotyping in media and role models (Steinke, 2017; Steinke, Applegate, Lapinski, Ryan, and Long, 2012). For example, these studies discuss that adolescent girls show heightened awareness of gender roles during these years.

One way children learn is via observing and imitating the behavior of others. Symbolic models, such as those depicted in mass media, have an influence on the available knowledge and ideas. This goes for scientist characters in media as well: adolescent conceptions of scientists largely extend from these images (Steinke, 2017, Archer et al., 2014). Archer et al. (2014) suggest that working-class students are more likely to be influenced by television than by the careers of family members or through out of school hobbies or activities, which is different for middle and upper-class students. In the Netherlands, people with non-Western migration backgrounds have on average lower incomes than people with Dutch backgrounds (CBS Inkomen, 2016). While more research is required before coming to a solid conclusion, these findings suggest that a media-based project could be beneficial especially for students from lower socioeconomic classes and/or non-Western migration backgrounds.

Media are an important instrument in projects focused on diversifying STEM. There exist a number of media-related projects already, for example: the charitable organization Visions of Science Network for Learning Inc. "aims to advance the educational achievements and career aspirations of youth from low-income and marginalized communities through meaningful engagement in […] STEM fields and research." (e.g. http://www.vosnl.org/ and https://www.instagram.com/visionsofscience/); the visibility campaign called 500 queer scientists, which shows the faces and short stories from queer scientists from all over the world (e.g. https://www.500queerscientists.com/

and https://www.instagram.com/500queerscientists/); and the website of VHTO I mentioned earlier (http://www.ditdoeik.nl/). I choose to focus on specific types of media such as websites, social media and magazines because they are popular, I have experience in these fields and because these are modern and manageable methods to reach the target audience via a new project, which I shall outline in the following chapter.

In my research, I shall draw on a diverse landscape of studies on intersectionality, science-identity, and the potential influence (and potential pitfalls) of media, to find ways in which we can encourage children from minority backgrounds in the Netherlands to actively identify with science.

Research questions:

1 Which current Dutch projects focus on attracting children to a technical study program in high school? How well do these projects fare with regard to attracting children from minority backgrounds?

2 What does a media-based STEM-project intended for Dutch children from minority backgrounds need? In which areas are current projects lacking?

3 What are the perceived experiences of Dutch children from minority backgrounds in STEM and how do these experiences impact the development of their science identities?

4 What is the impact of a specially designed media-based project on children's self-identification with science?

Research plan

To answer the research questions, I start with a literature review that focuses on existing research regarding drawing more children from a minority background into STEM, preferably via out-of-school and media-based projects (this will depend on the available research literature). I want to find out how and why certain approaches work or do not work, for example in regards of role models, counter stereotypical images of science, and increasing knowledge on the possibilities within STEM. Proceeding from there, I shall use documentary research to establish an overview of current media-based projects in the Netherlands. My findings will constitute the content of those projects, e.g. web pages, social network sites, magazines and videos. These results will be discussed using the information from the literature review, aiming to answer RQ's 1 and 2.

To answer RQ3, I shall interview 30 Dutch children with non-Western migration backgrounds (e.g. children from Morocco, Iran or Suriname). Their stories shall be unique and new, demanding a semi-structured approach as to let the interviewee develop ideas during the conversation and speak as freely as they want to.

Combining the results of RQ 1, 2 and 3, I aim to design a new media-based project, focused on helping children from minority backgrounds in finding their science identity, thus hopefully enhancing the possibility that they choose a STEM-based school program and a STEM career later on in life. The specific medium for this project highly depends on the answers to RQ's 1, 2 and 3. It could be a website, mobile app, Instagram page or magazine for example. Depending on the results of the first part of my research, this project may include: stories of teenagers with a particular science related hobby such as stargazing, building model airplanes or using a microscope; suitable role models who currently work in STEM, depicted in photographs, interviews or video's for instance; enjoyable fictional stories or cartoons that help shape the image of STEM and/or the science identity of the reader; articles about science (identity) from a more pedagogic point of view; and scientific news and fun facts, which are not directly connected to STEM-diversity but will attract readers who are interested in science.

To answer RQ4, I shall use a mixed methods approach combining survey questionnaires (n=100) and semi-structured interviews (n=30) with children that are engaged with the project described above. By combining quantitative and qualitative data, I will end up with a thorough and reliable conclusion on the effects of the new project, which I can use to answer RQ4 and to find new ways in which we can encourage children from minority backgrounds in the Netherlands to better identify with science.

Schedule

Year 1: follow courses, literature review, collect documents and data for documentary research
Year 2, first half: answer RQ's 1 and 2, doing the first series of interviews
Year 2, second half: answer RQ3, design the project
Year 3, first half: create content, test and launch the project
Year 3, second half: collect and analyze data for RQ4
Year 4: data analysis and writing

Qualifications and personal motivations

My passion for diversity in STEM and for examining society from an intersectional perspective did not begin with this PhD proposal, but originated and developed rather naturally over the last five or so years. During my Science Communication master, I focused my assignments on these topics as much as possible, because I am interested in them, I think they are very important for my own life and for society, and because these assignments, including my science communication research in the final year of my master, gave me the chance to learn more about the related topics and to gain some expertise in this area. In June 2017 I attended the Gender & Diversity summer school at the University of Groningen. I learned that I have come a long way, but that there is also very much left to learn. For example, I knew about intersectionality, but up until this summer school week in 2017 I did not fully realize its importance.

Another important part of my interests is media. I have learned a lot about the stereotypical images of science and scientists in movies, magazines and other types of media. But my interests go further than merely studying media, I also like to create content. I have experience with editing videos and creating and maintaining a blog. More recently I had the opportunity to do a weekly segment about science on Dutch public radio (NPO 3FM) and during my internship I wrote about science for the Dutch children's science magazine Zo Zit Dat, which focuses on 8 to 12-year-olds. While these children are younger than the age group I focus on in this research proposal, I learned valuable lessons in writing for a specific and young target audience.

As I hope to have made clear, both on a professional and a personal level I feel that my past experiences, interests and fields of study converge in this research proposal.

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