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Long Term, Interrelated Interventions to Increase Women's Participation in STEM in the Netherlands

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ABSTRACT

In this paper we describe the gender activities of VHTO, the Dutch National Expert Organisation on Girls/Women and STEM (www.vhto.nl), within the context of the Dutch national Universe and Sprint Program, which were designed to encourage more students to opt for STEM subjects in secondary education and advanced STEM programs in higher education (2004-2011). In this context, VHTO organised speed-dates for girls, teacher training and consultations with school managers in secondary education, and gender scan trajectories in higher STEM education. Statistics show that in the course of the Universe and Sprint Programs, more girls (and boys) opted for STEM subjects and higher STEM education, especially in pre-university secondary schools. In secondary schools that participated in VHTO gender activities, significantly more girls opted for STEM subjects and advanced STEM programs.

KEYWORDS

Gender equality; gender policy; gender mainstreaming; STEM education; educational career development and guidance



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INTRODUCTION

Since the early 1980s, VHTO, the Dutch National Expert Organisation on Girls/Women and STEM (www.vhto.nl), has been building up knowledge and experience about the participation of girls and women in Science, (information & communication) Technology, Engineering and Mathematics (STEM). VHTO has been deploying this expertise through the whole chain of education – from primary to higher education – and through the labour market in the Netherlands. Our experience over this period has demonstrated that it is essential to carry out interrelated interventions for a long period of time, instead of ad hoc or short term single actions.

Netherlands Low in Rankings

Traditionally, the Netherlands lag behind other countries in terms of the percentage of girls opting for STEM-study programs (Eurostat, 2009; OECD, 2003). The under-representation of girls cannot be attributed to differences in performance in STEM related school subjects or skills: girls perform as well as boys (Hyde et al., 1990), and this is also the case in the Netherlands (PISA, 2009). In international research a number of factors leading to the under-representation of girls/women in STEM have been recognized, including girls' lower self-concepts, non-stimulating learning environments, lack of female role models, stereotyped associations in society about girls/women and STEM, fertility/lifestyle factors, and career preferences of girls and women (e.g., Bøe et al., 2011; Ceci & Williams, 2010; Eccles, 2007; Eccles et al., 1999; Watt et al., 2006).

In the Netherlands, students are required to make educational career choices much earlier than in most other countries (see for instance Van Langen & Driessen, 2006). At this age (14-15) young people are still at the height of their development. This makes it extremely difficult to make decisions about academic and professional careers that will determine a significant part of their lives. It may be even more difficult to make non-traditional choices at this early age, such as girls opting for STEM. Moreover, school career advisers, teachers and parents in the Netherlands are more likely to advise boys to make academic career choices in the direction of STEM than girls, and sometimes even advise girls against such choices (Korpershoek, 2010).

Recent National Programs in the Netherlands

The Dutch Inspectorate of Education calculated that girls in secondary education form the largest potential resource of new intake into STEM fields. As part of a joint effort by the Ministry of Education and the (Dutch) National Platform Science & Technology (PBT), a three-tiered strategy (2004-2011) was designed to encourage more students to opt for STEM fields across three sectors of education:

- pre-VET (*Ambition Program*) (VET = Vocational Education and Training, age 12-16);

- pre-university secondary education (*Universe Program*), age 12-17/18; and
- university (*Sprint Program*), from age 17/18.

VHTO was a partner in these programs, specifically aiming at female students. Central to the VHTO approach was the deployment of role models and the emphasis on intake *and* retention *and* the successful outflow of students studying STEM programs. An outline of the program and its approach is described in this paper (full details are reported by Booij et al., 2011). We will describe the impact of the VHTO approach within the PBT programs; the effects described cannot be separated from the efforts of the Ministry and PBT. The VHTO approach explicitly focused on the career guidance of girls and on incorporating the gender perspective into school policy. Additionally, attention to girls and STEM was also an explicit focus in the monitoring and auditing process of the schools participating in the Universe and Sprint programs.

Role Models and Database

Female STEM professionals and students play an important role in boosting the involvement of girls and women in STEM. As role models they can show the broad range of STEM-study programs and professions, demonstrate that they enjoy their work, and are good at it. In these ways, they can support girls' self-confidence and interest in STEM-related subjects. Female students in secondary education are interested in learning what a day in the life of these role models is like, what studies they undertook and how difficult those are, what they like to do in addition to their study or work, and with whom. Role models are integral in many VHTO activities.

The women who participate in VHTO's activities all signed up for *Spiegelbeeld* ("mirror image"), VHTO's database containing more than 1,900 female STEM professionals and students. Not all women who have signed up for *Spiegelbeeld* turn out to be good role models; girls have to be able to personally identify with a role model. VHTO takes great care in selecting role models for speed-dates, guest lectures, work shadowing, mentoring etc. During speed-dating female STEM professionals (i.e., role models) are introduced to female students. Small groups of female students talk to the role models one by one. The role models have educational backgrounds in STEM and are now enjoying their job in the STEM field. By talking to various role models, girls obtain information about actual and present-day STEM professions and a better view on the broad range of professions in STEM fields. Speed-dates in the context of the Universe Program took place in schools for secondary education. *Spiegelbeeld* role models who are involved in speed-dating are trained by VHTO: they practise their presentation and are prepared for the questions and interests of the girls. On speed-dates in schools they are always accompanied by a VHTO-employee.

About VHTO

VHTO started in 1983 as a sort of equal opportunities unit of the Dutch Institutes of Technology (now the Science and Technology Studies Department of the Universities of Applied Sciences). Together with these institutes, VHTO developed approaches and instruments to attract more female students into STEM. In the

1990's VHTO started working with international partners in EU-projects, and joined several European networks that are (fully or partly) concerned with gender and STEM. Up until now VHTO has cooperated with many different partners in the Netherlands and abroad, designing and implementing intervention programs to raise the participation of girls and women in STEM. The speed-date sessions described below for instance, are based on the project *Ingenieur voor de klas* ("Engineer in the classroom"), designed and executed by VHTO and KIVI NIRIA, the Dutch association for engineers and engineering students.

From the beginning VHTO has actively drawn on academic literature about gender and STEM, to expand knowledge and to validate intervention programs and instruments. In 2009, together with Helen Watt of Monash University in Melbourne, Australia, VHTO started the Gender & STEM Network (www.genderandSTEM.com) with members who are researchers from all over the world. Nowadays, VHTO is *the* expert organisation regarding women/girls/gender & STEM in the Netherlands.

Focus on Girls in the *Universe Program* (Pre-University Secondary Education)

Dutch children are advised to follow one of three types of education at the age of 12 at the point of transition from primary (elementary) to secondary education: pre-VET (*vmbo*), general secondary education (*havo*) or university preparatory education (*vwo*). *Vmbo* students need to choose a specific sector to specialise in (agriculture, healthcare, technology, economics) only two years later. At *havo* and *vwo* the next defining moment occurs three years later, choosing a subject cluster: science and technology (ST), science and health (SH), arts and society (AS), or economics and society (ES). Once a society-subject cluster is chosen there is practically no opportunity to later switch to a science-subject cluster; however, in some cases it is possible to switch from science to a social cluster. In this paper we focus on *havo* and *vwo*, which have quite similar profiles.

Each school participating in the *Universe Program* had to develop policies and activities in six focus areas. The schools could choose the focus of attention and priority in each area. If they chose to focus on girls, they could ask VHTO for free support. VHTO combined interventions that had proven successful in previous years, which had yielded new insights developed into a strong combination of 1) activities for girls, 2) training programs for teachers and careers advisers, and 3) consultations with school managers.

Activities for Girls in Secondary Education (havo/vwo)

In *havo/vwo*, girls were introduced to female students and professionals, to become acquainted with the wide variety of STEM-study programs and professions. Female professionals (and students) from the Spiegelbeeld database visited schools at defining moments (i.e., in advance of subject-cluster choice, and choosing a higher education study program). The meetings with the role models were organised as speed-dates (see above). During these sessions the STEM professionals talked to small groups of girls about what a day in their lives looks like, what they like about STEM studies or work, how they got their job, what their ambitions are, and more. The aim was to give the girls an image they could identify with. The Spiegelbeeld

role models also gave guest lectures at schools and universities, mostly targeted at female *and* male students. This way both girls and boys learn that women can be experts in the field of STEM as well as men. Most role models also participated in the annual *Girlsday* at their company and will continue to do so in the future. Based on the US "Take our daughters and sons to work" initiative launched in 1993, *Girlsday* has been organised in Europe for more than 10 years, in order to promote interest of girls in STEM careers. Germany started *Girlsday* in Europe, followed by i.a., the Netherlands, Hungary, Denmark, Norway (see also in this issue: Jensen & Bøe, 2013). On *Girlsday*, participating girls learn about STEM careers first-hand by visiting a local STEM company or institution. In the Netherlands, organisations are matched with schools (only girls of age 10-15). The companies are asked to select female employees who are STEM educated and pursuing a STEM career to guide the girls through their visit and the activities organised for them.

Training Programs for Teachers and Career Advisers

These training programs focussed on gender awareness among science teachers, on breaking down stereotyped ideas concerning gender and STEM, and on gender-inclusive science teaching and career guidance. Teachers of the natural sciences, ICT and mathematics were invited to think of cases and examples that address the interests of both girls and boys. The training focussed on specific insecurities among girls, stereotyped associations (e.g., subconscious associations of science with men), and the effect of communication about "informal" additional requirements. For example, girls with an average grade of 7 or even 8 are often told that the science-clusters are too difficult for them, which reinforces their lack of confidence regarding these subjects. Teachers were taught how to create a positive image of the career potential in STEM for girls and how the girls can learn about developments in that area. With this aim in mind, VHTO recently developed a website with images and stories of male and female STEM professionals. Teachers can use the website titled 'This is what I do in STEM' as a tool to give themselves and their students a broader and more diverse view on STEM-professions and STEM professionals (www.ditdoeik.nl).

Consultations with School Managers

In these consultations, VHTO discussed with school managers how the theme gender/girls and STEM can be embedded in the school's policy (gender mainstreaming), that students' results and choices should be monitored by gender, and that gender policy and activities should be systematically assessed and, if necessary, adjusted.

Female Students in STEM Higher Education

During the *Sprint Program*, VHTO performed "gender scans" of STEM-study programs within universities, together with key figures involved in these study programs, such as the dean, program managers, intake manager, public relations officer, and sometimes students and/or science teachers from secondary schools. VHTO had developed the gender scan to map the opportunities for optimising policy and activities regarding gender/girls and STEM. In the *Sprint* period, gender scans were followed up by a VHTO action plan with a focus on female students, a full day workshop on how to implement proposed actions, and the formation of a gender

core team. The main aim of a gender scan trajectory under the *Sprint Program* was to raise gender awareness, to formulate and implement relevant actions, and to create a group that would feel responsible for pushing the gender theme within the university.

The gender scan includes five themes: 1) Institutional policy, 2) Outreach to female *havo/vwo* students, 3) Educational innovation, 4) Orientation on professions and professional practice, 5) Regional networks. We will discuss the gender scan method here, as it relates to the other activities in the scope of the VHTO-approach. More details about the gender scan trajectory can be found in Booij et al. (2011). The gender-scan sessions and the one-day workshop succeeding it, often led to new ideas about how to improve the intake, retention and successful outflow of female students in the advanced STEM-study programs.

Institutional Policy

In this theme the focus was on gender mainstreaming, quantitative awareness, staff policy and the importance of a gender core team.

Gender mainstreaming. Most universities appeared to be aware of the female potential, but often they did not know how to address it. They were advised to incorporate an overall gender perspective within a longitudinal policy, for as long as women remained underrepresented in STEM fields. All policy intentions and the resulting activities should be assessed on their effectiveness for female and male students (i.e., gender mainstreaming).

Quantitative awareness and targets. Policy adjustments and/or activities which targeted the STEM-related increase of women's intake, success rates, and the number of graduates moving on to programs such as research Masters, can partly be made on the basis of numbers/percentages of women who enrol in STEM-study programs. The numbers provide insight in the effectiveness of activities, and about how female students value the activities. Reasonable, yet ambitious targets should be formulated to provide a common goal and trigger gender awareness at all layers of the universities.

Staff policy. Universities are putting more effort in trying to increase the diversity in academic staff teams in STEM fields. Explicit efforts to attract women staff have been made and women are more often represented within committees to appoint new academic staff members. A number of research universities have also set up fellowship programs and are seeking to retain young women scientists by creating specific tenure tracks for women. Diversity among the academic staff would not only improve research and education, but could also show that women are welcomed and taken seriously.

Gender core team. To embed the theme of gender and STEM within an organisation it is important that people feel responsible for this, and that there is adequate commitment, time and funding. A working group or a gender core team, including researchers, (human resource/education/outreach) managers, teachers and advisors from the various STEM-study programs would have the advantage that

gender mainstreaming and specific gender policy become a shared responsibility, which facilitates the process of gaining support for the theme of gender and STEM.

Outreach to Female havo/vwo Students

In this theme, the focus was on information activities for *havo/vwo* girls within science-subject clusters, with special attention for their teachers and parents. Universities were motivated to organise “girls only” activities such as high teas, speed-date sessions, or guest lectures. These activities were mostly enacted by women university students in STEM fields.

Universities also organised outreach for parents, teachers, and career advisors. Parents consider STEM studies a good option, but they do not know what these programs can offer their daughters. Some universities organise separate workshops for parents to provide them with more information about STEM-study programs and career perspectives.

For teachers it is important to have up-to-date information about STEM-study programs and careers as well. Some universities started information sessions attended by both women and men including lecturers, students, professionals, and small-business entrepreneurs, to update teachers’ image of STEM professions and careers.

Innovation of Study Programs

Educational restructuring or innovation is an excellent opportunity for gender mainstreaming. The success of restructuring can be assessed by means of carefully monitoring the impact of changes and their effect on intake, retention and outflow of male and female students.

Many girls are interested in social implications of STEM topics (Ceci & Williams 2010). In new degree programs in the Netherlands (e.g., “Earth and Economics” and “Medical Technology”) factors such as coherence, contextual relevance and multidisciplinary have been taken into account. These programs show a substantial increase in the intake of both female and male students (PBT, 2011). When redesigning study programs it is vital to manage the expectations of potential students. Universities should present a realistic picture of the study program, and the title of the study program should support and reflect the content.

Orientation on Professions and Professional Practice

The gender scans revealed that only very few universities, particularly research universities, prepare their students for a career in business. Information about all career prospects is vital when it comes to recruiting and retaining female students, and in encouraging them in the next step in their (educational) career. It is easy for men to enrol in a STEM-study program, but women need more information before they decide to study STEM subjects. Female students profit from contact with women professionals (e.g., in guest lectures and workshops). These professionals act as role models and help the students to feel confident in their (educational) career choices, especially when there are few other female students around.

Regional Networks

Universities could be more successful in reaching out to girls' with STEM potential, in intake, retention and successful outflow into the labour market of female students, when they cooperate with partners from their "intake market", of schools for secondary education, and their "outflow market", of companies who might employ their students.

In recent years, various Dutch universities have invested in collaborations with secondary schools (*havo/vwo*). They are active in providing information about fields of study and advanced programs, in designing science lessons for secondary education, in providing guest lectures, in the supervision of subject cluster projects, and in the continuing professional development of STEM-subject teachers. Gender differences in STEM have been a regular topic of discussion within these networks. Information activities specifically aimed at girls (e.g., girls' days and girls' camps) have been set up together with secondary education career advisors and teachers. Collaboration with companies varies by university. Close collaboration with (innovative) companies appears to have great impact on student motivation. Female students indicate that working together on real life, innovative cases and projects provided insight into the social relevance and the utility of STEM-study programs. Alumni, especially women who work for the companies that act as partners in projects, appear to be valuable links to the business sector and serve as role models. Also, they can provide feedback about the relevance of their STEM-study Program for their professional practice, by describing the knowledge and skills that are essential for their current jobs.

RESULTS

In the period of the PBT Programs (2004-2011) the percentage of *havo/vwo* students enrolling in a science-subject cluster increased dramatically, as an effect of extra attention to science in the educational program. The schools put considerable effort into boosting the students' enthusiasm for science-subject clusters, and they succeeded. The quantitative evaluation of the PBT Universe Program showed that in "VHTO schools" more girls opted for a science-subject cluster than average. Moreover, secondary schools and universities reported a higher level of gender awareness in the evaluation, but how exactly this is reflected in their practice, apart from the support for activities focusing on girls and STEM, is difficult to measure.

Secondary Education: "VHTO effect" in Universe Program

During the Universe program, 183 *havo/vwo* schools made an effort to boost student enthusiasm for the science-subject clusters. The participating schools also worked hard to encourage their students to move on to advanced STEM-study programs. The statistics showed that these schools succeeded both in increasing the number of students choosing a science-subject cluster, as well as in increasing the number of students subsequently proceeding into an advanced STEM program. The vast majority of the schools (145) collaborated with VHTO to enhance a specific focus on female students. PBT examined whether the science-subject cluster scores and progression outcomes of schools that worked with VHTO differed from those of other schools. The average number of girls choosing a science-subject cluster was

higher in "VHTO schools", both at *havo* and *vwo*. Particularly in the case of *vwo*, the average rates were significantly higher (Dialogic, 2008, 2011).

Tertiary Education: combined "VHTO effect" in Universe-Sprint Programs

The *Sprint Program* was not evaluated quantitatively; instead, universities peer-reviewed each other. Although all universities performed a gender scan of their STEM-study programs, this resulted in very different action plans. We thus present statistics from CBS Statistics Netherlands, which provides generalised data, but no data on specific programs or program evaluations.

As mentioned before, the number of *havo/vwo* students who opt for a science-subject cluster has increased recently. This group of students is the prospective intake for STEM higher education. We expected the increase in the popularity of science-subject clusters would be reflected in the intake statistics of STEM higher education.

At the universities *for applied science*, women's intake in STEM-study programs increased, whereas male intake decreased, in the period 2005-2009. A difference between two kinds of STEM-study programs was found: 1) study programs with 100% STEM-related subjects, and 2) study programs with more than 50% STEM-related subjects (excluding those programs mentioned in 1). In 2009, for study programs with 100% STEM-related subjects, the percentage of women's intake was 16.7% compared with 14.0% in 2005; for the study programs with more than 50% STEM-related subjects women's intake was 47.4% compared with 44.4% in 2005.¹

The intake of students in *academic* STEM study programs increased by 62% since 2000. This increase is largely attributable to increasing numbers of women students: since 2000, there has been an increase of 73% of female students in STEM-study programs; in the same period the intake of women students into non-STEM-study programs increased by only 26%. The percentage of women in the Science sector of academic education is much higher than in the Technology sector: 39% versus 19% (2005-2009, average because of fluctuations due to educational innovations).²

Recently, a number of Dutch universities reported a strong increase in the number of student applications for science studies. There are indications that in particular, more girls have opted for these studies. Presently, detailed intake figures broken down by gender, are not yet available.

WHAT'S NEXT?

The number of prospective female STEM students is still increasing. More and more girls in secondary education or pre-university (*havo/vwo*) opt for a science-subject cluster. This is subsequently reflected in an increase in the intake of female students into STEM higher education. It would seem that clearly, the efforts made within secondary and higher education did have a positive impact.

Unfortunately, many female *havo/vwo* students with a science-subject cluster still do not opt for an advanced STEM-study program after secondary school. More

detailed research could be carried out on the motives of these girls: more effective and more structured career guidance during upper secondary education might encourage more girls to become interested in advanced STEM programs in higher education.

Also, general Dutch statistics show that only a small percentage of women STEM graduates proceeded into a professional career in STEM sectors of the labour market. This does not necessarily mean that these women are not or are no longer employed in STEM-related positions. They could be working in the service sector, at a hospital, in education, or for the government. It would be highly interesting to study in greater detail where women STEM graduates go, and in which areas or branches they find their first jobs. The question is whether this trend of increased participation by girls and women in STEM will continue, now the *Universe* and *Sprint Programs* have ended. There are other initiatives to stimulate schools and girls/women to opt for science oriented programs, but they are on a much smaller scale.

In 2011, VHTO commenced a large scale project on talent development and the image of STEM professions in primary education. In order to meet the demand of schools, VHTO is creating a database containing pictures, stories and short videos of women and men STEM professionals. The database can be used for educational purposes and is in line with the personal perspective that is employed in the speed-date sessions. Furthermore, VHTO runs smaller scale choice and career guidance projects in secondary education and organises *Girlsday* annually³. Recently, in Dutch politics (and in several other countries) a lot of attention has been given to recruiting young people for STEM education and STEM professions. As long as girls and women are underrepresented in STEM, particularly in STEM education, girls and women should receive specific attention in every government-initiated project that focusses on the STEM area. Specific policy concerning the recruitment of female students, constant attention to gender mainstreaming, and investing in a long term integrated approach may pay off in the (near) future.

ENDNOTES

¹ Statistics from the Knowledge Base of Platform Science Technology (PBT), Netherlands: <http://kbt2012.kiwi.qdelft.nl/Default.aspx>. Original sources: Dutch Ministry of Education; CBS/Statistics Netherlands.

² See footnote 1.

³ EU countries exchange experiences on *Girlsday* in EU network and project meetings. The VHTO *Girlsday* Manual for organisations and schools is available in Dutch and English (www.girlsday.nl).

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