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Empowering teachers' gender sensitivity

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Abstract

To this day, few girls in secondary and higher education opt for technology courses, which is reflected in the labour market. In order not to lose this potential, education must focus on gender sensitive teaching, more specifically when it comes to technological activities.

It requires certain insights, skills, and sensitivity to effectively empower girls in science and technology. Previous research is often widespread and not translated into concrete practice. For this design study, we brought together previous research and developed the Gender Sensitive Education Checklist (GSEC) in such a way that it evokes a sense of urgency for teachers and empowers teachers and edutainers in this quest. In an additional workshop we presented the checklist and its four main pillars regarding gender sensitivity in education, namely attitudes, representation, interaction, and pedagogical methods.

Teachers can use the developed checklist both as a practical tool, or as a reflection tool when designing and organising their activities. They scale their own skills, talents, and challenges on a continuum from strong to less strong in response to the relevant questions, relating to the four main pillars. Teachers can also, by using the checklist, be "just-in-time" reminded to make small adjustments to their lessons or workshops and by this means support girls more adequately in their STEM career.

Through multiple feedback-loops, qualitative questionnaires, and focus groups, we have learned that both (student-)teachers and edutainers consider the checklist to be a meaningful support. Teachers recognise a gender sensitive approach in STEM as very important, but also admit that they missed opportunities in the past because

they did not know how to tackle these challenges and were not always conscious about the existing stereotypes and bias concerning gender. They indicate that after the workshop, they are motivated to teach in a more gender sensitive way, by focusing on some of the offered practical tools and tips.

Keywords

Gender sensitivity; teacher training; equity in STEM

Introduction

Already at the age of twelve, girls are less interested in a future in STEM than boys (Denessen, et al., 2015; Ardies et al, 2015a). This untapped potential talent is a waste on a personal, social, and economic level (Van den hurk et al., 2019). Certainly, in times of shortages in technological professions, a society cannot afford to neglect professional talent.

We know that this gender gap in STEM is more bias driven than ability driven (Brown, 2021). Both students, teachers, and parents believe boys are better at STEM than girls, which influences the support and chances girls get in this field. In a study by Newall and colleagues (2018), for example, teachers in a blind test indicated that girls are less proficient in physics than boys. If teachers believe, implicitly or not, that girls will enjoy STEM-oriented education less, they can encourage them less and even make them feel that they do not belong there and that they are not competent in technology or science (Eddy & Brownell, 2016; Wang & Degol, 2013). It is important that teachers become aware of these implicit biases and ideas, as they do influence their interactions with students.

What do we already know?

The role of teachers

Gender biases influence students, teachers, and parents (Newall et al, 2018; Ardies et al, 2021). They are particularly difficult to unravel as they are part of the standing and accepted cultural environment in which children grow up (Brown, 2021). Because both implicit and explicit biases of teachers influence the motivation, attitudes, and proficiency of girls and boys in technology (and broader, STEM), the starting point of this study is the teachers' self-reflection in order to map out their own strengths, mindset, and blind spots around gender-sensitive teaching. For this purpose, we developed a checklist, the Gender Sensitive Education Checklist (GSEC), that starts from a solid basis or ground condition concerning gender (sensitivity) as a first pillar, and further focuses on three pillars, namely imagining/representation of girls and STEM, interaction, and teaching methods (Dierickx et al, 2022).

Because this checklist serves as a reflection tool, teachers can mark on a non-numeric scale the extent to which they believe they (don't) agree with a statement or question. In this way, we emphasise the possibility of growth within gender-sensitive teaching, rather than see it as a measurable, quantitative subject.

What teachers need to know

Since knowledge and consciousness of existing ideas, stereotypes, biases, and biased interaction patterns are the first steps in improving gender equity, a gender sensitive fundamental attitude is indispensable. The teacher needs to step away from a so called “gender blind” attitude (Garrahy, 2001), which is an ideology where people claim they don’t see differences between genders and treat boys and girls in the same way. This is a harmful attitude, as it ignores historical and current different treatments between people of different genders. It is indeed important to be aware of the influences of gender on our own thinking and behaviour (Consuegra et al., 2013) before taking further steps in the design process of gender-sensitive STEM-lessons. This awareness, or ground condition, is the first of four pillars of the GSEC, where we offer teachers two reflective questions (see attachment).

The second pillar is about the imaging and representation of girls and technology. Children form an early image of what an engineer looks like. When children are about seven years old, they have already absorbed the idea that boys are naturally better at STEM. These stereotypes only get more entrenched as they grow older. These biases are not innocent, as they make girls lose confidence, motivation, and interest in STEM subjects, even when their grades are good (Brown, 2021). Once girls internalise the harmful idea that math is for boys, they turn their academic selves away from math and towards languages (Steffens & Jelenec, 2011). Female role models and role models who challenge STEM-stereotypes can have a positive influence on the attitudes of both girls and boys towards women in technology (Cheryan et al., 2011). The most effective role models are those with similar backgrounds to those of the participants. That resemblance can encourage girls to imagine that one day they might end up in those specific positions (Martens et al, 2006; Smeding 2012; Zirkel, 2002).

Opposed to what some teachers might believe, feminising the study or work environment by adding glitter and pastel colours, for example, doesn't provide more motivation for technology education for girls. On the contrary, this “pinkwashing” can reinforce in girls the idea that this is not the course for them by emphasising their gender, which is associated with negative stereotypes about STEM (Heybach & Pickup, 2017). In other studies, the addition of pastel-coloured blocks in a game did not positively affect girls' technical ability, but negatively impacted boys' performance (Mulvey et al., 2017). Previous research confirms that much of the learning material and imagery used in STEM classes still enhance the stereotypical idea that science is associated with white men (Kerkhoven et al., 2016; McGuire et al., 2020).

The third pillar focuses on interactions in the classroom. Teachers perceive little difference in the way they interact with boys and girls, while research suggests that boys and girls are treated differently in terms of how (often) they get feedback, compliments, and support (e.g., Consuegra et al., 2016). Further, our language use has a major influence on our students. Children actively look for cues about gender in their environment to organise and make sense of their social world (Martin & Ruble, 2004). Even without any experience with technicians or physicists, for example, one may learn about their stereotypical gender from language. Languages encode gender in multiple ways. These include, for example, gender-specific titles (Mr. versus Miss.), pronouns (he versus she), certain job titles (waiter versus waitress), and higher-order linguistic associations (gender-neutral words can become gendered by association with explicitly gendered contexts i.e., we think of a “scientist” as a man). In most European languages there is a distinction between the male and female form of scientist, for example. Past studies show that language can influence stereotype formation (Cimpian & Markman, 2011; Rhodes et al., 2019). Other research shows that naming science as behaviour or action rather than as a fixed identity contributes to the interest of young girls (4 to 9 years old) in technology. These effects

are especially true for children who are targeted by stereotypes (e.g., girls) that suggest that they may not be the kind of person who is successful in STEM (Rhodes et al., 2019). This is of large importance, as many girls and those around them think that succeeding in this field is a matter of an innate and fixed talent as opposed to something you can work for and grow in (Hill et al., 2010, Ardies et al, 2015a).

The fourth and last pillar handles different teaching methods. Connecting students' lives and their lessons can increase interest and outcomes, especially for students with low success expectations (Hulleman & Harackiewicz, 2009). Girls also seem to prefer a contextualised curriculum, in which technology is seen as a means to solve social problems or to enrich human experiences, and previous studies indicate girls feel even more motivated if they can design and conduct their own research (Ardies et al, 2015b).

Research questions

We developed a checklist (Dierickx et al, 2022) and workshop based on the need to help teachers critically look at their own practice. And to support them to develop more gender-sensitive lessons where possible. This led us to the following two research questions:

- How do teachers and education professionals experience the checklist and the accompanying workshop?
- What are teachers' perceptions about their gender-sensitive teaching, and do they experience a difference after using the checklist and participating in a workshop?

How the research was done

Context: Introducing the workshop and checklist

We organised different workshops to promote gender sensitivity in STEM-education, in which a new version of the checklist was introduced. The workshop took two hours, during which the four aspects (general gender awareness, imaging girls, classroom interactions, teaching methods) were systematically reviewed. The necessary theoretical background and relevance was explained, interspersed with practical examples and the participants' chance of interaction. For the development of the workshop, we started from the work of Merchie et al. (2016). In this way we assured ourselves of effective elements, such as at least a context-bound approach and attention to reflection. Inspired by Van Thienen (2013), in our workshop we made use of appreciative inquiry. Based on a description and reflection of reality (one's own workshop or teaching practice) and projecting a dreamed future (gender-sensitive STEM-activities), we arrived at concrete plans and growth points.

Participants

A total of 58 participants participated in one of the organised workshops. Forty-two of them participated in this study by completing the survey afterwards. The first six participants were edutainers, professionals who support teachers in organising STEM-activities through extra-curricular workshops. Second, 31 in-service teachers participated. Secondary education teachers were the most widely represented (n=25), next to six primary education teachers. In order to obtain participants for the second feedback loop of the checklist, a mailing was sent out to more than 1000 primary and secondary school teachers in Flanders, Belgium. The secondary teachers were teachers with a technological or scientific

background. We received a positive response of 58 who were interested in our workshop. Due to the Covid-19 measures in force, we were obliged to organise the workshops online. Teachers who registered received a package in advance at home containing a poster with the four statements, as well as the checklist in the form of both a brochure and a bookmark.

The last five participants were pre-service teachers from our own university college.

In the group of teachers and edutainers there was a diversity in gender and age that is representative of the population.

Method

The checklist and accompanying workshop were designed, (re)developed and evaluated based on the framework for educational design research (EDR) from McKenney and Reeves (2012) (Figure 1). EDR has proved to be an effective approach for research projects focused on the design and evaluation processes of instructor training programmes and initiatives (Dede et al, 2009). The research method of EDR is characterised by its iterative nature, in which the practical and theoretical output is developed in close relation to the field of practice (McKenney & Reeves, 2012).

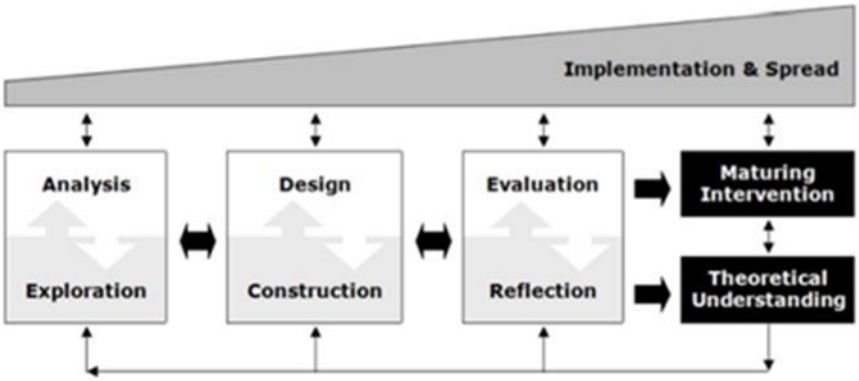

Figure 1. Generic model for conducting educational design research (McKenney & Reeves, 2012).

In the first phase, we designed the checklist and workshop, based on literature reviews. Next, the instrument was reviewed and re-designed through multiple feedback-loops. In the first feedback loop, the edutainers reviewed the instrument and workshop. Based on their feedback, the instrument was revised and tested in a second feedback loop by teachers. A third version of the instrument was evaluated by student-teachers. Afterwards, a fourth and final version of the workshop and the GESC was developed (Dierickx et al, 2022).

Instrument

A survey was used to evaluate the checklist and the workshop. The survey consisted of both closed- and open-ended questions.

Checking the checklist

After the workshop, we asked the participants to complete a questionnaire about the checklist and the workshop.

In general, we surveyed teachers' perceived self-esteem about gender-sensitive teaching with two questions. For this, the respondents could indicate to what extent they agreed with the question about their gender-sensitive teaching:

- Before this workshop I already taught in a gender-sensitive way.
- After this workshop I will teach in a more gender-sensitive way.

Are there things you will do differently during your classes after attending this workshop?

Next to open-ended questions, participants indicated on a 5-point Likert scale to what extent they agreed with the following statements:

- I find the checklist easy to use.
- I understand everything that is quoted in the checklist.
- I would also understand the checklist if I had not followed the workshop.
- Using the checklist can help me to organise lessons in a more gender-sensitive way.
- I think I would use the checklist again later.

Finally, participants answered three open questions about the checklist:

- What do you like about the checklist? Multiple answers possible.
- What do you dislike about the checklist? Multiple answers possible.
- Is there anything you think could be added or addressed differently?

Checking the workshop

First, using a 5-point Likert scale, participants indicated to what extent they agreed with the four statements about the workshop:

- I found the workshop clear and informative.
- The workshop ensures that I will organise my lessons in a more gender-sensitive way.
- The workshop has given me new insights.
- I would recommend the workshop to colleagues.

Second, participants answered four open questions about the workshop itself.

- Why did you attend the workshop? What did you hope to learn?
- What did you like about the workshop? Multiple answers possible.
- What didn’t you like about the workshop? Multiple answers possible.
- Is there anything you think could be added or addressed differently?

Results

In this section, we first describe the results of the quantitative questions of the survey, followed by a more detailed analysis of the qualitative data.

Perceptions of the participants

The questionnaire was administered after the workshop. The focus of these questions was to estimate the extent to which teachers feel that there is a difference before and after the workshop. In this way we indirectly gauge their self-efficacy and perception of the workshop and checklist.

Most teachers who participated in the workshop indicated that they are already engaged in gender-sensitive teaching, at least to some extent. This is of course as expected, as they voluntarily participated in a workshop on gender-sensitive teaching in science and technology. However, there were only two participants who gave themselves the highest score.

Table 1. ***Frequency of Participants Self-perception on Gender Sensitivity Before and After the Workshop Divided Per Category***

	Strongly disagree	Disagree	Agree nor disagree	Agree	Strongly agree
Before					
Edutainers			2	3	1
Students		2	3		
Primary teacher			4	2	
Secondary teacher		4	7	13	1
After					
Edutainers				2	4
Students			1	2	2
Primary teacher				4	2
Secondary teacher			1	14	10

How participants experience the checklist & workshop

Most participants (35) indicated that the checklist was easy to use. Regarding the comprehensibility of the questions, there is an agreement (35 out of the 42 participants) that the checklist is easy to interpret. Most participants (29) also agreed that the checklist would be understandable without having participated in the workshop.

Thirty-two participants indicated that the checklist is helpful in organising lessons in a more gender-sensitive way. On the other hand, 13 participants indicated at the end of the workshop that they doubted if they would re-use the checklist ever again. Three of them explained their response, one participant defined the checklist as “cumbersome”. One other participant declared that the scale was difficult to use. It might have been easier if it worked with bullets to represent the scale. And the third participant found the checklist “rather confusing”, as it wasn’t clear to him from which perspective to fill in the list.

The other 10 participants who doubted whether they would re-use the checklist nevertheless stated that the list was clear and easy to use. And although they indicated that they would probably no longer use the checklist, they did imply that they would scan their lessons to make them more gender-sensitive.

Almost all participants (38) found the workshop very informative and most (37) indicated that they would teach in a more gender-sensitive way after the workshop. Most participants (39) stated that the workshop had given them new insights.

Perceived changes in teaching practice

Teachers gave concrete examples of changes in behaviour and didactics they were going to implement after the workshop and implementation of the checklist. It was noticeable that they mainly included mostly small and relatively "easy" tips. Most of these come from within the pillars "guidance and interaction" and "imaging".

In terms of imaging, the intention of screening for language and images in student workbooks or manuals stands out. Nine people indicated that they explicitly wanted to pay attention to the role of women in the course materials.

Eighteen participants indicated that they would pay extra attention to their language. They would use gender-neutral job titles more consciously and/or apply both the male and female version. Nine participants (from which seven teach in secondary education) said they wanted to focus on gender stereotyped beliefs of their students. Six participants talked about language adaptations in general.

The participants hardly discussed more complex and structural adjustments in didactics or pedagogical approaches, such as consciously opting for collaborative instead of competitive tasks. A possible explanation for these results is that these adjustments are less concrete and less immediately visible than the ones mentioned above. Other possible explanations could be that the suggestions concerning more complex and structural didactics and pedagogics could already be known by the teachers, or that these suggestions were discussed rather shortly and at the end of the checklist and workshop.

Growth in gender sensitivity?

Based on the figures from Table 1, we can determine that the participants' perceived gender sensitivity has increased during the workshop. If we look in more detail at this evolution, 11 participants, of which seven are secondary teachers, indicated that they have not increased. However, these specific participants indicated that they were already strongly to very strongly gender-sensitive before the workshop. Most participants (21) rated themselves one step higher after the workshop than before. The distribution is equal between the different participants, students, primary or secondary teachers.

Discussion

Although girls are equally talented in STEM (Blickenstaff, 2005; Ceci & Williams, 2010; Eddy & Brownell, 2016; Wang & Degol, 2013), they are remarkably less likely than boys to choose a field of study in the field of STEM (Departement Onderwijs en Vorming, 2019). Because teachers have a central role in promoting STEM to their pupils, but they often teach in a predominant "gender-blind" way (Garrahy, 2001), we examined how teachers can be supported in gender-sensitive teaching. Therefore, we designed a checklist and corresponding workshop for teachers in primary and secondary education in Flanders.

This study was conducted on a representative but relatively small group. Fifty-eight participants attended the workshop of which 42 evaluated the workshop and checklist. The conclusions of this study can therefore be interpreted in that respect.

A first conclusion is that the checklist was found to be a useful and practical tool to help organise lessons in a more gender-sensitive way. We therefore recommend making the checklist more accessible (and easier to use digitally). A possible way to further disseminate this checklist is through an online platform where teachers can evaluate their own actions and get concrete advice just-in-time.

Second, most teachers evaluated the workshop as valuable and indicated that their behaviour has changed since attending the workshop. A sidenote to these results should be made: we didn't measure teachers' factual change in behaviour, nor their capabilities. We only examined their ambitions and self-indicated sense of growth in this subject. Nevertheless, multiple studies showed that teachers' perceptions, self-efficacy, and ambitions to change their lessons can be seen as an indicator for actual change in teaching behaviour (e.g. Bandura, 1977; Klassen & Tze, 2014; Chen et al, 2021).

In line with previous research (e.g., Consuegra et al., 2016), the results of this study indicate that further professional development is necessary to support teachers in gender sensitivity. Given the Covid-19 measures in force, the workshops had to continue online at the time of the investigation. We expect that an offline workshop will have an even stronger effect, as the interaction between the participants and the experts can then be more in-depth. In addition, we recommend implementing longer and more in-depth professional development trajectories for teachers, since one-off workshops do not warrant the most sustainable change in attitudes and behaviours. More hours of collective and professional development are needed (Merchie et al, 2016). A longer and more in-depth professional development course also has the potential to focus on supporting gender-sensitive teaching within a whole school team and in school policies and thereby supporting teachers that do not (yet) see the importance or have resistance to gender-sensitive teaching. More research is still needed.

In conclusion, the majority of the participants indicated that they had gained new insights during the workshop and by using the checklist and showed intentions for behavioural changes in the classroom to make this a more inclusive and ambitious place for students of all genders. The checklist and workshop therefore seem promising in promoting more gender sensitivity in STEM-education.

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