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Gender and Diversity Awareness Among STEAM Teachers: Perspectives for Gender- and Diversity-Sensitive Technical Education

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Abstract

Technology education faces the challenge of appealing equally to all learners, regardless of gender and background, and empowering them to actively participate in a technology-driven world. Raising awareness among teachers about gender and diversity issues plays a key role in this. The article focuses on gender equality in creative and technical educational contexts. For several years now, the focus has been on promoting girls and women in STEM subjects. Teachers of technical subjects should address this key educational and socio-political challenge, as gender-specific differences in interest and self-concept manifest themselves at an early age.

This study examines the knowledge and attitudes of teachers in STEAM subjects (science, technology, engineering, arts, mathematics) with regard to gender- and diversity-sensitive teaching. It is based on a quantitative online survey of $N = 511$ teachers from Tyrol (Austria), which was conducted using validated Likert scales. Differences according to gender, subject taught, and experience with monoeducative teaching settings were analysed. The results show that teachers with different educational backgrounds and experience in gender-segregated education show greater awareness of the importance of gender-equitable lesson planning. Finally, there is potential for further developing STEM programs into STEAM approaches, in which art and creative forms of expression are consciously integrated.

Key Words: Gender Competence, Diversity, STEAM, Teacher Training

1 INTRODUCTION

Gender describes socially and culturally shaped gender roles that go beyond biological differences (Gildemeister & Wetterer, 1992). Gender equality means recognizing diverse identities and overcoming structural disadvantages. It is enshrined in international agreements such as the UN Charter of Human Rights (1948) and the SDGs, in particular Goal 5: "Achieve gender equality and empower all women and girls" (UNDP, 2015). In pluralistic societies, gender

equality is not only an ethical imperative, but also the foundation for stability, inclusion, and democracy. It promotes social justice, individual rights, freedom, and participation (Fraser, 2013; Butler, 1990; Walby, 2005). It is also considered a benchmark for openness, tolerance, and economic stability (Sen, 1999; WEF, 2023). Culturally, gender diversity broadens social discourse and promotes creative forms of expression (Hooks, 1984). Studies show that gender-equal societies are more peaceful, happier, more innovative, and more economically successful (UN Women, 2020; OECD, 2021; Catalyst, 2020). Currently, there is a lack of critical reflection on gender studies in teacher training and lesson planning (Bartsch & Wedl, 2015).

2 GENDER AND DIVERSITY: DEFINITIONS AND CURRENT RESEARCH

In German-speaking countries, the term diversity is often understood as cultural diversity in anti-discrimination measures (UNESCO, 2001) or as a means of maximizing benefits in management contexts (Roosevelt, 2001). While the term originally derives from the concept of biodiversity, such as the diversity of species or ecosystems in biology (Schaal, 2016), in the context of sociology it is mostly used synonymously with diversity (Salzbrunn, 2014). Today, gender mostly refers to social gender and encompasses attributed behaviours and characteristics (Wirtz, 2013). Several projects fostering women in STEM subjects in schools are currently being carried out in Germany, although teachers are rarely the focus of these projects (see, for example, https://www.komm-mach-mint.de/MINT-Projekte/Projektlandkarte).

Diversity in the school context of technical disciplines can therefore be understood as a heterogeneous composition of students, which bring together, for instance, different gender groups, students with and without a migration background, or students with and without special educational needs (Goreth & Windelband, 2020). Teachers must respond to this heterogeneous group of learners. Diversity competence enables them in (technology) education to appropriately deal with diversity and gender-related aspects. Studies on gender and technology (in the context of STEAM) within subject didactics focus on various aspects. Surveys that evaluate the implementation of gender and diversity aspects in technology education—using mixed-method designs—utilize classroom observations (observation sheets) and student surveys (Goreth et al., 2021). Further studies show that interest is reflected in gender-specific ways depending on the specific content area, as evidenced by students' responses in self-assessments. Gender-specific differences are particularly evident in the scientific and technical context (Virtanen et al., 2015; Kosack, 1994; Mammes, 2004; Brown, 1993; Goreth et al., 2021). The extent of technical socialization is also lower among female students than among male students (Goreth, 2026, submitted). Within STEM education, self-concept shows significant gender-specific differences, which also vary according to actual competence levels (Jann & Hupka-Brunner, 2020), and, alongside parents and internships, plays a decisive role the choice of a technical profession or course of study (Brämer, 2019; Acatech, 2011).

Furthermore, the background factors influencing students' career choices have been identified based on their experiences of technical socialization (Goreth & Vollmer, 2021), and also gender differences have been found in teachers' interests and knowledge of subject-related content areas (Goreth, 2021). Teachers with experience in mono-educational settings also demonstrate greater awareness of the importance of gender-sensitive teaching (Goreth & Lutz, 2025). There is a need

for empirical research across the various domains within STEAM education. This article therefore focuses on an online questionnaire study involving teachers in the broader STEAM field, aiming to examine their attitudes toward and knowledge of gender and diversity.

3 RESEARCH DESIGN

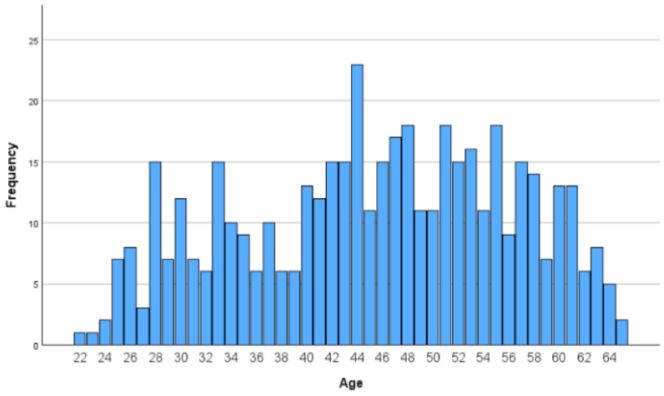
The goal of this quantitative online survey, conducted via *soscisurvey* and primarily targeting teachers in Tyrol (Austria), was to assess teachers' knowledge of and attitudes toward diversity and gender. A total of $N = 511$ teachers took part in the approximately 15-minute survey (Goreth & Lutz, 2025). Five-point Likert scales were used:

- Scale Gender in the Teaching comprises five items. Example item: Coeducational teaching has a beneficial effect on the academic development of female students.
- Scale Importance of Gender comprises six items. Example item: I believe it is important to offer different levels of complexity.
- Scale Planning/Reflection on Gender and Diversity comprises five items. Example item: I reflect on the extent to which my attitudes are influenced by social gender role perceptions.

This article addresses the following research question: What role do gender aspects play in teachers' attitudes toward teaching and lesson planning, and are there differences depending on the combination of subjects taught by teachers?

Figure 1

Age Distribution of Surveyed Teachers



The sample of this study has an average age of $M = 45.4$ years ($SD = 10.6$) and is predominantly *female* (68.4%), with a smaller proportion of *male* participants (30.9%) and individuals identifying as *diverse* (0.6%). For the statistical analysis of gender differences, individuals who selected "other gender" were excluded due to low absolute numbers (3). Consequently, no statistically valid conclusions can be drawn for this group.

Figure 1 shows the age distribution of the teachers surveyed in Tyrol (Austria), who range in age from 22 and 65 years old. The subjects taught by the surveyed teachers are also relevant for the analysis. Participants were divided into three groups: teachers who teach *STEM subjects without additional art classes*, teachers who teach *STEM subjects with additional art classes*, and teachers who *do not teach STEM subjects*.

An AI translation tool (DeepL) was only used to assist with the translation, which was then proofread.

4 RESULTS

The results of the teacher questionnaire are presented in this section and provide an overview of the data collected and key findings from the survey.

Figure 2

Definition of diversity (mentioned by N = 159 teachers; the size of the mention indicates the frequency; own illustration)

Teachers ($N = 159$) were also asked to define the term diversity in their own words. This resulted in the following frequency pattern (see Figure 2). The size of each term represents how frequently it was mentioned by the teachers. Only part of the teachers surveyed were reached via the open text field. These are presented here.

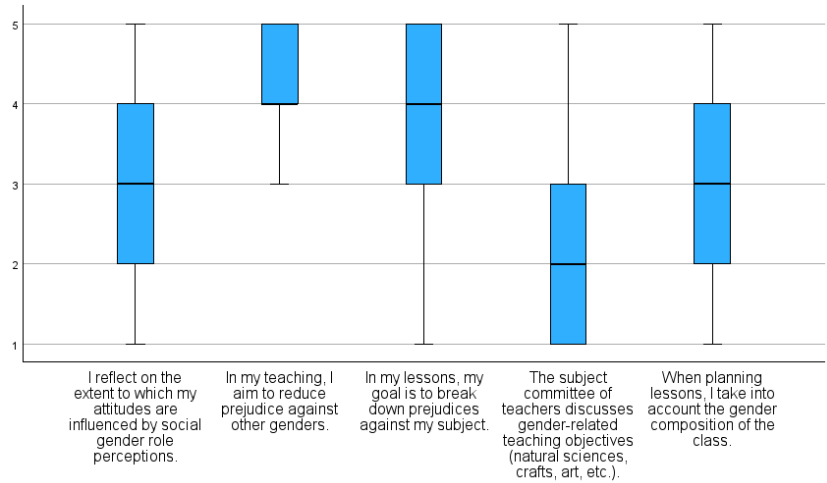
In German-speaking countries, the term “Vielfalt” (diversity) is most often used as a synonym for diversity. The terms “Unterschiedlichkeit” (difference) or “unterschiedlich” (different) and “Unterschied” (difference) are also frequently used to define the concept. Furthermore, explanations such as “Gruppe” (group) or “Menschen” (people) can also be identified.

The items *“In my teaching, I aim to reduce prejudice against other genders.”* and *“In my lessons, my goal is to break down prejudices against my subject.”* are rated above the midpoint of the scale. In contrast, the items *“When planning lessons, I take into account the gender composition of the class.”* and the item *“I reflect to which my attitudes are influenced by social gender role perceptions.”* are rated neutrally.

The median of the item *“The subject committee of teacher discusses gender-related teaching objectives (natural, sciences, crafts, art, etc.).”* is below the midpoint of the scale. Collaborative work and cooperation within the teaching staff is generally not desired or pursued. Instead, teachers consciously tend to address work on gender-related aspects individually.

Figure 3

Items on the “Planning/Reflection on Gender and Diversity” scale on a 5-point Likert scale from 1 = “strongly disagree” to 5 = “strongly agree”



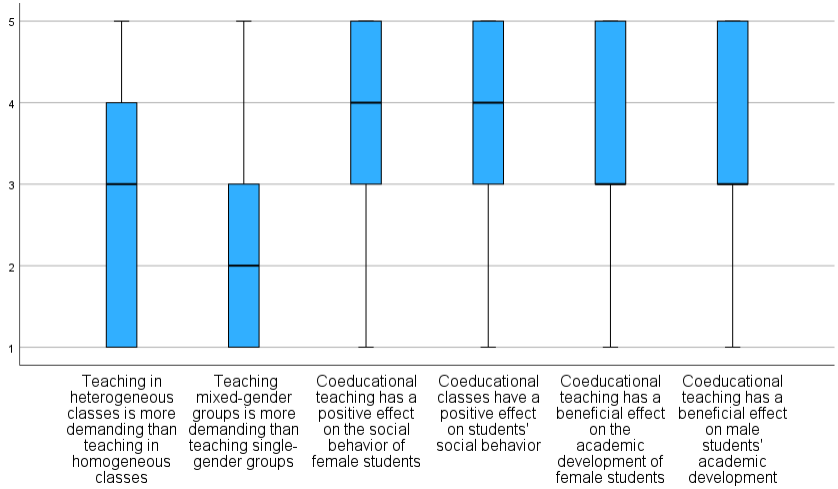
Similarly, teachers indicate less interest in cooperative formats for continuing education on gender than in other continuing education formats on the topic of gender. The median level of interest in using cooperative formats to continue education on gender is 2, which lies below the

midpoint of the scale, and the Q3 quartile is 3, meaning that 75% of respondents are undecided about or opposed to the possible use of cooperative formats (see Figure 3).

The items *"Teaching in heterogenous classes is more demanding than teaching in homogenous classes."* and *"Teaching mixed-gender groups is more demanding than teaching single-gender groups."* are rated as neutral to slightly below the midpoint of the scale. Coeducation is rated above the midpoint of the scale for both *boys* and *girls* in terms of social aspects, with a median of 4. *Academic development* is also rated almost as positively, with only 25% of respondents rating it below the midpoint of the scale.

Figure 4

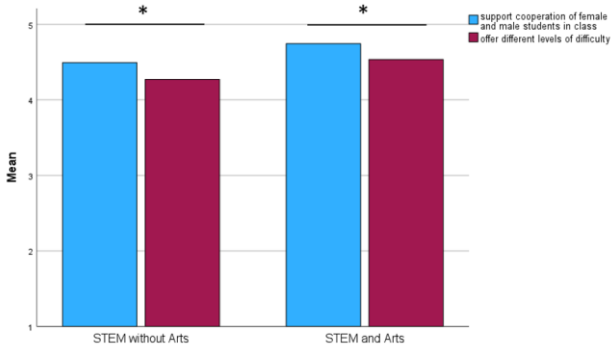
Items on the "Gender in the Teaching" scale on a 5-point Likert scale from 1 = "strongly disagree" to 5 = "strongly agree"



Heterogeneous or mixed-gender teaching is not considered to be more *demanding* than more *homogeneous*, and particularly, *mono-educational class compositions*. Positive effects are consistently associated with coeducational teaching experiences in both social and *academic development* for *female* and *male students* alike (see Figure 4).

Figure 5

Influence of teaching an Arts subject on STEM teachers regarding in class teaching, items on a 5-point Likert scale from 1 = "strongly disagree" to 5 = "strongly agree"



Teachers who teach *STEM subjects and also teach Arts* report a greater tendency to encourage cooperation between female and male students in class ($M_{STEMandArts}$ = 4.74, *SD* = .84) than *STEM teachers who do not teach Arts* ($M_{STEMwithoutArts}$ = 4.49, *SD* = .56) at *t*(252) = -2,94; $p < 0.05$; *d* = -0,36. *STEM teachers who also teach Arts* are likewise more likely to offer different levels of difficulty ($M_{STEMandArts}$ = 4.53, *SD* = .66) than *STEM teachers without Arts* ($M_{STEMwithoutArts}$ = 4.27, *SD* = .89) at *t*(262) = -2,81; $p < 0.05$; *d* = -0,34 (see Figure 5).

These differences represent small effects located in the upper range of the scale. Overall, STEM teachers who also teach art express greater confidence in their ability to contribute to gender-sensitive teaching practices than STEM teachers who do not teach Arts.

5 DISCUSSION, LIMITATIONS, OUTLOOK

The results presented here illustrate that gender-related issues are no exception when it comes to forms of cooperation addressing educational issues. As reported in previous studies, teachers often perceive themselves as working independently and shy away from offers of support involving forms of cooperation related to teaching, similar to the findings of Gräsel et al. (2006). This is accompanied by the sobering realization that encouraging cooperative activities through continuing education events must be considered difficult. Schadt et al. (2022) note that, despite the well-documented advantages, cooperative activities may also be perceived as a burdensome. Perhaps this is where we should start in order to strengthen the willingness to cooperate and cooperative activities among teachers.

At the same time, teachers themselves express very positive attitudes toward promoting forms of cooperation between female and male students. The positive correlation between a teacher's

connection to artistic subjects and STEM subjects also appears to have a positive influence on teachers' cooperation and awareness of differentiation in relation to their students.

The explicit affirmation of coeducation of male and female students reflected in the presented results aligns with the correlations reported in Lutz and Goreth (2025), between teachers' prior experiences of single-sex education and a stronger reflection of gender aspects in lesson planning. This supports the deliberately restrictive idea formulated in that study to experimentally test single-sex settings, particularly in teacher education, as a means of fostering more reflective consideration of gender aspects within coeducation teaching and learning experiences. Such environments are considered beneficial both theoretically and empirically, a view shared by most participants in the present study.

The scales used in this quantitative survey provide insight into a broad group of practicing teachers. The survey instrument is valid. However, closed research designs offer little in-depth insight into differing perspectives. A complementary qualitative interview study using questions derived from the results could certainly be beneficial.

Although these findings can only be assumed for Tyrol (Austria) so far, the STEAM approach can be discussed as an extension of the classic STEM subjects to include artistic, creative, and design elements (also to promote interdisciplinary problem-solving skills). STEAM then pursues the goal of not only strengthening technical and scientific skills but also integrating creative and social aspects.

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