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Social disparities in students' access to STEM and Art

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Abstract

The aim of the project "Circus of Knowledge" is to investigate the extent to which art in science education, for example drama and dance, contributes to increasing pupils' interest in STEM topics. As there are no comparable studies in Austria yet, both primary and secondary level are researched. To do so, we surveyed 419 children aged between of 10 and 15 years. Specifically, we investigated whether students from a socially disadvantaged background (i.e., students who rarely or never speak German at home or students with parents having less prestigious jobs) report less experience with art and science than students from a more privileged background. Our analyses showed that students' social background is not linked to students' STEM and Art experiences. Rather, gender and age play a significant role in predicting experiences with STEM and Art.

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1. Introduction

Austria has been struggling for years with a shortage of specialists in the STEM field (Dornmayer & Winkler, 2018). At the same time Austrians are one of the most sceptical ones towards science and technology (European Commission, 2019). To reduce this scepticism and to make science more accessible, the Sparkling Science 2.0 project "Circus of Knowledge" (CoK) links natural sciences, which is often perceived as abstract by students, with art, which challenges students' creativity. In the three-year CoK-project, STEM teaching material are taught by means of artistic interventions and instructions. The aim is to make STEM topics more vivid, tangible, and thus interesting to students. Moreover, the use of creative forms of teaching and learning should help to ensure the long-term retainability of the students' learnings. Since (scholastic) learning is strongly influenced by students' family background, special emphasis was placed in the CoK-project on including schools with pupils from the most diverse social classes. As evaluating the potential of art in science education to reduce educational inequality is a central aim of the CoK-project, this paper addresses the existing differences between children with different social backgrounds.

2. Theory

Theoretical theories explaining educational inequality include the concept of primary and secondary effects of origin by Boudon (1974) or the theory of capital by Bourdieu (1983). Primary effects of origin include socialization effects that differ between social classes. Examples are differences in early childhood support (i.e., differences in the intellectual stimulation potential of the environment), the language culture used, attitudes towards school and education, or learning habits. These differences in socialization could lead to an advantage for children from privileged families when it comes to learning (Becker, 2017). These primary effects of origin are closely linked to the concept of resources of origin (Blossfeld et al., 2019). Bourdieu's (1983) capital theory is often used to explain such resources (Becker, 2017). *Economic capital* describes a family´s financial resources that are available for learning support. *Cultural capital* describes competences acquired through the socialisation process. *Social capital* includes the support of a certain group affiliation (Blossfeld et al., 2019). These theories lead to the interesting question of whether there is a difference in access to art and science between pupils from different social classes and different levels of socio-economic capital.

3. Methods

Sample. 419 students from 7 primary and secondary schools in Upper Austria with 14 classes in total participated in the quantitative survey. The students were aged between 10 and 15. To investigate changes over time, students are surveyed at six measurement points over 3 years, starting in 2022. This paper presents the results of the first project cycle (November 2022 - June 2023).

Questionnaire. To investigate social disparities regarding students' access to STEM and Art we asked about students' home language (never, sometimes, mostly, always – we grouped them to German = mostly/always, Not German = sometimes/never) and parents' occupation. Pupils could choose their parents' current occupation from a list, the options were based on the occupational profiles according to International Standard Classification of Occupations (ISCO-08). To assess students' access to STEM and Art students were asked to report how often they engaged in different STEM and Arts-related leisure activities (e.g., LEGO Technic, theatre visits). Additionally, information on age, gender and STEM grades was collected.

Analyses. To examine social disparities in access to STEM and Art, we looked at descriptive statistics as visualized by bar plots as well as inference statistics, i.e., correlations and regressions. Due to the proximity in time of the data collection and this first paper, only initial data review analyses were made. Further in-depth analyses will be conducted and published at a later date.

4. Results

Descriptive statistics. Figure 1 shows the mean values of students' access to STEM and Art separated by students social background and home language.

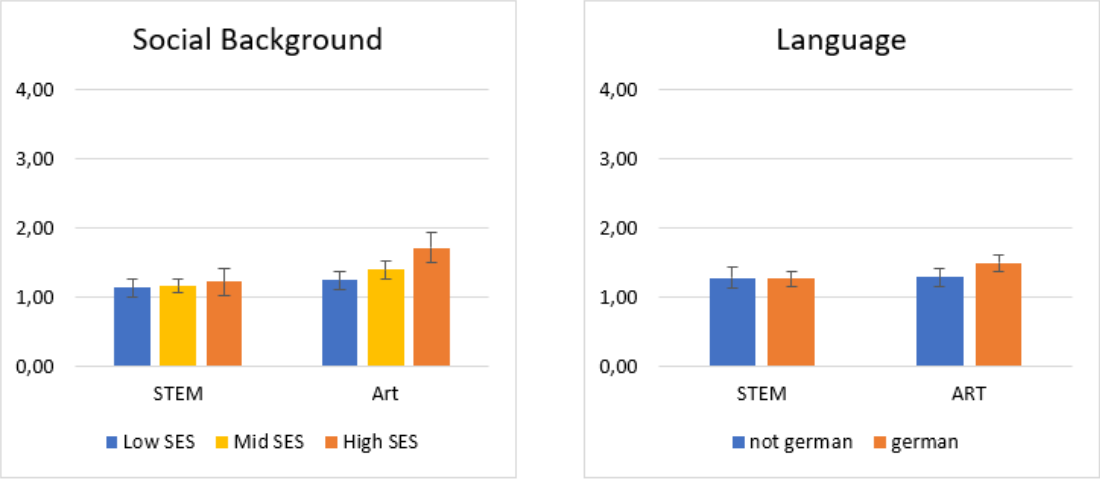

Figure 1: Mean comparison

Figure 1 shows that low or middle SES students, on average, have descriptively less access to the Arts than high SES students. But there is no evidence for significant differences between German and non-German speaking children regarding their reported access to STEM and Art.

Correlational analysis. Bivariate correlation analysis (Table 1) shows that art experience is negatively linked to students' social background (SES), whereas STEM experience is not significantly associated with students' social background. The findings for the language spoken at home are very similar: Students that report to speak non German languages more often at home, also report less experience with art. However, STEM experience appears independent from students' home language. Since further student variables such as gender, age and grades are linked to STEM and Art experience, we did regression analyses in the next step to check if the associations of interest change if further student characteristics are controlled.

Table 1: Correlations

	Social Background	Home Language	Gender	Age	STEM Grades
STEM Experience	-.06	-.06	-.12*	-.37***	-.28***
ART Experience	-.20***	.13*	.12*	-.37***	-.34***

***p<.001, **p<.01, *p<.05

Regression analysis. Multivariate analyses show that for the prediction of both "access to art" and "access to science", social background (STEM: β = .039, p = .430; Art: β = -.066, p = .209) and the language spoken at home (β = -.043, p = .413; β = -.026, p = .632) are not (any longer) associated with access to art and science when taking into account the age (collected continuously) and gender (0 = male, 1 = female, 2 = diverse, but we had no response to diverse) of the students as well as their school performance. Rather, age (β = -.226, p < .001; β = -.302, p < .001), gender (β = -.188, p < .001; β = .117, p = .014), and student performance (β = -.110, p = .042; β = -.216, p < .001) are predictive.

5. Discussion

Although descriptive and correlational analyses suggest weak effects of students' social background on their experiences with STEM and Art, multivariate regression analyses show that these effects disappear when students' gender and age are considered. The correlation between grades and access to STEM and the Arts fits into a series of similar findings. Krapp et al. (1993) conducted a meta-analysis of studies on the relationship between interest and academic achievement in STEM subjects. They reported a correlation between access to STEM and the Arts and grades. The results on gender differences in access to art and STEM confirm the prevailing stereotypical views on the experiences and interests of girls and boys. Girls' higher experience of arts and boys' higher experience of STEM subjects have frequently been confirmed by studies (e.g., Gardener, 1985; Quaiser-Pohl, 2012). The fact that students' interest in STEM subjects decreases with increasing age is also in line with existing research (Gardener, 1985). The missing direct relationship between students' social background and language use at home, on the one side, and STEM and Arts experiences, on the other side, may also be attributed to the large number of missing values that occurred when primary students' were asked about their parents' occupations. For the follow-up survey, teachers will be asked to work through the occupational groups with their students so that the missing data can be recorded. Although the study design has limitations, this project is the first of its kind in Austria, and thus provides a first valuable look into young students' access to STEM and Art. Given these early findings, the following implications for the practice can be made: STEM topics must be presented in an exciting way, especially for older pupils, in order to generate sustainable and long-term interest. In order to inspire girls as well, they should be educated about the fact that many typical female professions also come from the STEM field.

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