SECONDARY STUDENTS' ATTITUDES TOWARDS SCIENCE BASED TECHNOLOGY – AN EXPLORATORY STUDY

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Abstract

As part of a bi-national cooperation project between industry and Swiss- or Austrian secondary schools we explore the students' attitudes towards STEM. There is a shortage in STEM related professionals and interest of students for STEM careers is low. Our project aims at fostering students' interest in STEM professions by out-of-school visits in industries. We present first descriptive data from the ongoing research study. This includes attitudes towards science based technology related to value, cost, self-schemata, and socializer's beliefs. Results indicate that beliefs are rather low in general and as expected significantly lower for girls. Best motivational predictors for career interest in science related technology are enjoyment, personal interest and a high self-concept in science based technology. We hope that our second wave will show higher beliefs as a result of our project.

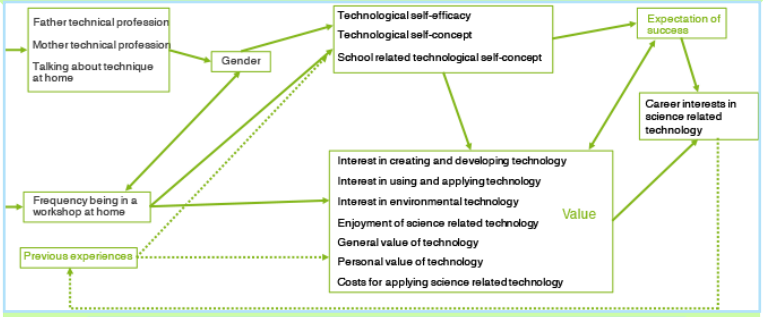

Fig 2: Research model based on Expectancy-Value Model of Eccles & Wigfield (2002)

Research question for this presentation

What is the state of the secondary school students' attitudes related to science based technology?

Sample

Our sample for the presentation consists of 116 students from 4 secondary school classes in the Eastern part of Switzerland (M = 13 y). All of the classes participate in the project „STEM becomes a habit in schools" (2016-2018). More participants as well as additional data from Austrian schools (project partner) are expected in the near future.

Method

The project began 2016 and lasts for three years. Its design is longitudinal with a pre- and post-measurement. Our research is embedded within a Swiss-Austrian project that aims at developing positive students' attitudes towards science based technology by visiting STEM related industries. Local teachers and an industry partner design one or more day out-of-school visits were students work on authentic tasks related to the company's products. Students fill out a questionnaire twice whereas the teachers and a company representative are interviewed. Therefore, the research design is also mixed-method. The questionnaire items relate to the expectancy-value model of achievement by Eccles and Wigfield (2002; Fig. 2). The Items were adapted from e.g., Flake, Barron, Hulleman, McCoach, and Welsh (2015); Guedel (2014); OECD (2006).

Fig 1: Girls assembling a 3D-printer

		M	*SD*	1	2	3	4	5	6	7	8	9	10
1	Technological self-efficacy	3.97	1.05	1									
2	Technological self-concept	3.81	1.01	.51**	1								
3	School related technical self-concept	3.69	.86	.47**	.75**	1							
4	Interest in creating and developing technology	3.56	1.23	.38**	.44**	.47**	1						
5	Interest in using and applying technology	3.35	1.26	.66**	.55**	.51**	.67**	1					
6	Interest in environmental technology	3.59	1.11	.42**	.33**	.39**	.68**	.55**	1				
7	Enjoyment of science related technology	3.43	1.17	.69**	.58**	.52**	.58**	.88**	.51**	1			
8	General value of technology	3.74	.84	.20*	.18	.36**	.38**	.37**	.34**	.38**	1		
9	Personal value of technology	3.72	.95	.32**	.50**	.58**	.51**	.56**	.39**	.53**	.44**	1	
10	Costs for applying science related technology	3.06	.92	-.46**	-.72**	-.55**	-.44**	-.64**	-.27**	-.63**	-.14	-.45**	1

Fig. 3: Attitudes towards technology. Pearson product-moment correlations $^{**}p < .001$, $^{*}p < .01$. All scales 1-6, α >.80.

Background

Student attitudes toward science are part of the PISA 2006 definition of scientific literacy (Bybee, McCrae, & Laurie, 2009). They underlie an individual's interest in, attention to, and response to science and technology. Career intentions for STEM correlate with general interest in STEM subjects (Kudenko & Gras-Velázquez, 2016). Students attitudes towards science correlate with student outcomes in science and in consequence predict STEM study selection (Guo, Parker, Marsh, & Morin, 2015). These findings suggest that interventions targeting the promotion of academic performance and STEM pathways, should seek to enhance both self-concept and intrinsic value. To do this, utility value interventions, such as identifying personal utility value connections between students' lives and what they are learning in class, have been found to be effective to trigger students' interest and promote academic performance in STEM topics (Hulleman & Harackiewicz, 2009). Also, out-of-school experiences seem to enhance the students' interest for the STEM field (Henriksen, Jensen, & Sjaastad, 2015).

Results

- Secondary school students' attitudes related to self-concept or value of technology are rather low (Fig. 3). Female students have generally lower attitudes.
- While around 50% of the fathers have a technology related occupation only 9% of the mothers do.
- There is no difference for students' career choice between groups with father or mother having a technological profession or not.
- Students never or seldom talk about technology or are in workshops at home. Both variables are positively correlated with self-concept and career choice.
- Based on the first four teacher interviews it shows that teachers seldom integrate technology related tasks in science lessons.
- All scales from the expectancy-value model related to self-concept and value correlate (Fig. 3). Both also correlate with career choices.
- Three scales are particularly strong predictors for career choice (Fig. 4). They explain 57% of the variance in career choice.

Career interests in science based technology			
	M	SD	β
Enjoyment of science based technology	3.43	1.17	.34
Interest in science based technology	3.73	.94	.37
Self-concept in science based technology	3.82	1.01	.18
N			112
R^2			.57

Fig. 4: Standardized coefficients for regression model of secondary students' career interests for science based technology, M = 3.13, SD = 1.14; all predictors $p < .05$. All scales 1-6, α >.80.

Discussion

We expected and obtained low attitudes towards science based technology with a gender effect (Kudenko & Gras-Velázquez, 2016). We also detected that science based technology is not yet a topic in science lessons at secondary school in Switzerland. This is however not untypical for other regions as well (Jones, Buntting, & de Vries, 2013). Hence, up to now, students who have no contact with technology at home, did not have the chance to develop positive attitudes during adolescence. Therefore, the visits in the industry as part of our project „STEM becomes a habit in schools" represents a unique opportunity for students to discover undiscovered talent or interest for STEM professions. The second wave of our measurements will show whether students have positively changed their attitudes. This might depend on the individual project each local school-industry cooperation has designed.