ABSTRACT
Images of science, engineering and technology (SET) are often connected to outdated clichés about nerdy scientists and boring engineers representing various gender stereotypes. According to current studies many of these stereotypical schemes are still active and have great impact on study decision making processes and students’ job expectations in the field of SET. This paper will discuss first results of the European project MOTIVATION, which is looking for factors influencing young people’s perception of SET and SET education. Results from pupils’ interviews and content analysis of youth magazines will be presented, in order to answer three main questions: First, how do upper secondary school pupils perceive the image of SET? Second, what influences this pupils’ image of SET? And third, how could secondary school pupils get more attracted to SET study and job fields?

Keywords: youth, SET, gender, media, science education, informal learning

1. European Situation
The European Council stated in the year 2000 in its Lisbon strategy that by 2010 Europe should be the most competitive knowledge-based economy in the world (http://ec.europa.eu/invest-in-research), but the number of students in science, engineering and technology (SET) degree courses is declining in many European countries. For instance Austria, Denmark, Italy, Germany, Hungary and Finland experienced a drop in the share of university graduates with science and engineering degrees between 1998 and 2004, as did Korea and the United States [1, 2].
Another field of action is the under-representation of women in SET fields. In the European Union (EU), in engineering, manufacturing and construction degree courses 75.7 % male students face only 24.3 % female students [3]. And although the current students’ assessment study PISA [4] found no significant performance differences of female and male pupils in science; mathematics, science and computing degree courses have a huge gender imbalance as well (63.1 % male vs. 36.9 % female students in the EU [3].
In an EU-wide survey 82% of all interviewed persons agreed that “young people’s interest is essential for the future prosperity of Europe” [5, p.100]. Already in 2001 a “young people and the scientific vocation crisis” was proclaimed in Europe [6, 7]. One reason for that situation is answered by two thirds of asked senior school pupils and students who stated that “scientific lessons are not appealing enough” [6]. European science education recognized a need of a “renewed pedagogy” in schools, which does not isolate science classes from remaining subjects creating some kind of mono-disciplinary subculture [8, 9].

2. MOTIVATION – a European project on changing the image of SET
The partial results we are going to present here have been gathered in the frame of the European project MOTIVATION1 (www.motivation-project.com). The project aims at learning more about factors which influence the image of science,

1 MOTIVATION is funded as Coordination Action within the 7th Framework Programme of the European Commission. Involved are the following persons: Felizitas Sagebiel (coordination) and Jennifer Dahmen in Germany, Anita Thaler and Christine Wächter in Austria, Anne-Sophie Godfroy-Genin and Cloé Pinault in France, Els Rommes in the Netherlands, Carme Alemany in Spain, Bulle Davidsson in Sweden and Natasa Urbanciková and Gabriela Kolvekova in Slovakia.
engineering and technology (SET) of secondary school pupils in order to attract more young people for those study and job fields [10]. In this paper, we will focus on two main areas of the project: SET education in schools and SET representations in youth magazines [11]. Therefore, we want to investigate, how teachers and science education at school can contribute towards more positive attitudes of pupils towards SET subjects. Teachers are besides family and friends of great importance for job and study orientation processes of young people [12] and work as role models as well. And additionally, we want to assess the informal learning potential of youth magazines, focusing on the manifestation of SET representations. Media receptions can be seen as informal learning experiences, which form young people’s images of science and engineering, enhance SET-interests and young people’s self-beliefs as well.

**Methodology**

The MOTIVATION project used and uses different methodological tools. Focus of this paper is the exploratory analysis of SET school education in Europe and quantitative and qualitative content analysis for youth media research.

**Interviews with pupils and teachers**

For the interviews with female and male pupils a biographical approach was used. The guideline included questions about young people’s experiences and opinions regarding SET in different settings of their lives like at parent’s home, at school, among peers and in media. Altogether 14 interviews with pupils of upper secondary schools in Austria and Germany were carried out.

Further evidence about the ways how science is taught at school nowadays was obtained through eight interviews with teachers at two schools in Germany. Despite information about didactics, the interviewees were asked among others about their perception of SET at school and the image of SET among pupils.

**Magazine analysis**

For identifying, describing and comparing SET representations in youth magazines a data sheet has been developed and the data has been statistically processed [13]. Supplementary a qualitative content analysis of the detected gender representations in SET images was prepared. Technology for the project purposes is defined in a layperson’s view, means technological artefacts like machines, hardware, and software and SET professionals for instance scientists or engineers. The idea was to analyse technology representations, which would be recognised as technology by teenagers too (ibid.). For deeper analyses three popular youth magazines in Austria and Germany have been selected as a sample 3. The sample comprised 22 issues of the German “BRAVO” – a very popular youth magazine for more than 1.6 million female and male readers weekly – further six issues of the monthly published Austrian „Xpress”, and in contrast to these two magazines which are both focussing on female and male audience, seven issues of girl’s magazine “BRAVO GIRL!”.

**Results**

In this paper we refer to the Austrian and German results which are based on the above mentioned investigation methods.

**Science education at school**

The students’ assessment – PISA – study 2006 [4] focusing on science education has shown that especially by the way science is taught in many schools in Europe, pupils have only rarely the opportunity to carry out experiments, to generate and test ideas of their own and to apply scientific knowledge to their everyday lives. With our research we wanted to get an insight into today’s science teaching and how it is perceived from both sides – the teachers and the pupils. Especially young people’s opinions are in the centre of our interest: what do they say about their science lessons and what does good teaching mean for the pupils? The latter question can be answered quite simply at first glance: having fun! But on the second view it is obvious that pupils have a concrete picture of what they prefer or dislike about teaching. Pupils in our sample emphasised liking hands-on work at school, trying out experiments in chemistry by themselves or constructing robots. It is important for them to experience science by themselves and not only in frontal lessons: “Everything should be approached step by step, also in practical work. So you can learn it better as if you only read it” (quote interview GF1_2). Reflecting teachers try to offer these learner-centred didactics and experience the motivating character of experiments: “Chemistry means for them, everything has to explode and so on. It has to stink and in best case some colours should appear. Yes. I try to offer this to my pupils. Because they should stay motivated and behind this motivation is a kind of research ambition, the curiosity is behind” (quote interview GMT1_3).

The uttered didactical preferences of the pupils for hands-on work, experiments and interactive

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2 Interviews with pupils in Austria were conducted by Sabine Stockinger, in Germany by Jennifer Dahmen, Felizitas Sagebiel and Christina Schultes.

3 The magazine analysis has been done by Jennifer Dahmen, Anita Thaler and Magdalena Wicher.
Education research has shown that learning is most effective in settings where learners can act as teachers as well. To think about how to explain something and how to teach others is a very effective learning strategy. Therefore it can be deduced that especially SET learning should be connected up to contexts where pupils can see the relevance of school subjects and become aware of their implicit knowledge. For instance realize that their often informally learned technology skills can help them with classes in schools, by connecting SET with spare time topics like internet games or music technology [14, 15, 16]. Teachers mostly are aware about the fact that learning is supported by close to live examples, like the following utterance of a male science teacher shows: “I always try to find examples close to their living reality, as far as it is possible. Often questions arise from the pupils…” (quote interview GMT2_3).

The fact that pupils connect SET jobs often to their SET teachers at school underlines two important aspects. At first, there seems to be a lack of realistic and diversified SET job information and at second, teachers serve as SET role models for their pupils. The latter point leads to another, the importance of positive attitude towards SET on both sides – on the teachers’ as well as on the pupils’ side: Teachers who transfer their enthusiasm about SET (teaching) to their classes seem to be a highly motivating effect. Learner-centred and informal learning approaches do not replace good didactics and good teachers. Moreover, teachers have to become aware of their powerful positions during the socialisation process of young people on the content level of their powerful positions during the socialisation process of young people on the content level of young people. This interdisciplinary gender-sensitive technology learning process realizes what we learned from our MOTIVATION interviews with pupils: It enables upper secondary school pupils to make hands-on-experiences, experience problem-based science learning, learn in teams, apply own competencies and experience SET as a topic with relevance to their everyday lives.

Informal learning potential of youth media

Altogether 801 representations of SET were analysed in the Austrian and German youth magazines. 491 SET images stem from the weekly published German “BRAVO” magazine. That means in average 22.3 SET images are published per issue. 111 SET images were found in the Austrian “Xpress”, which makes in average 18.5 analysed SET images per issue and 87 SET images were analysed in the seven analysed German “BRAVO GiRL!”, that is a comparable lower number of in average 14.5 SET images per issue [13]. The three analysed magazines have a different share of females and males represented in their SET images. While “Xpress” and “BRAVO” equally often portray females and males with science, engineering and technology, the girls’ magazine “BRAVO GiRL!” certainly emphasize their female target audience by presenting females in two thirds of their SET pictures.

Talking about SET images in youth magazine, it is certainly interesting what fields of technology are covered by that term. We found out that the SET field are not surprisingly connected to topics typically presented in youth magazines: music technology (277), followed by vehicles (133) like
In the question of gender differences of SET images, we could learn that there is no relevant gender difference within the “gender neutral” magazines, but moreover within the girls’ magazine and in between different magazines. So we found out that pictures with males in “BRAVO” and “Xpress” – the magazines aiming at boys and girls – are showing music technology nearly to the same extent than in SET pictures with females (“BRAVO”: 38.9 % males, 41.0 % females; “Xpress”: 34.8 % males vs. 35.2 % females). But both “gender-neutral” magazines show music technology generally more often than “BRAVO GIRL!” And within “BRAVO GIRL!” there is a gender difference concerning SET pictures representing music technology (21.2 % males, 33.3 % females).

Two other SET fields differ in the analysed magazines: cell phones and vehicles. While cell phone technology is relatively more often presented in “BRAVO GIRL!” than in “BRAVO” and “Xpress” interestingly the girls’ magazine “BRAVO GIRL!” shows cell phones/handhelds more often in SET images with males – vehicle pictures could be more often found in “BRAVO” (21.4 % males, 16.4 % females), than in “Xpress” (15.3 % males, 11.5 % females) and least often in “BRAVO GIRL!” (12.1 % males and 5.0 % females) [11].

In the qualitative content analysis of the youth magazines we focused on the one hand on SET pictures portraying male and female persons in the same picture, so that we could analyse the represented gender relations. On the other hand, we searched for SET images which could be seen as good practice, in the sense of giving realistic job information or bearing true SET knowledge which can be useful for informal learning processes. We can shortly summarize, that all analysed youth magazines have gender stereotypical and gender equal SET representations as well. But unfortunately, gender equal SET representations contain mostly unrealistic SET representations, using technological artefacts more as accessories than in their real technological context [13].

Representations of SET professionals are generally rare, but a positive exception is the irregular published job special of “BRAVO” called “job attack” [German “Job Attacke”], which introduces so called dream job fields to the audience, informs about educational and legal aspects of SET and other professions. These magazine parts can be considered as good practice initiative for SET job information and counselling and those job specials are more or less identical with the previous mentioned 3.1 % of portrayed SET jobs of all analysed youth magazines (ibid.).

3. Conclusions

Although the image of science, engineering and technology (SET) is a complex concept, the interview results pointed out that science education in upper secondary schools and the role of teachers are very influencing for the image of SET that young people learn: SET is taught too theoretically and with a lack of hands-on experiences. And teachers are not only crucial for the development of enthusiasm for SET but moreover they are the first and sometimes only role model for SET professionals [11]. However, the qualitative and quantitative content analyses of magazines could show that SET is not an unusual topic in youth magazines. But opposite to official SET job information in the internet or in flyers, youth magazines embed SET mostly in popular leisure topics, like music, movies or even gossip about famous persons. These results strengthen current SET education approaches aiming at a connection of SET with leisure topics of teenagers, to use those youth interests as a vehicle to transport SET in an appealing and meaningful way [16].

Representations of SET professionals were hard to find in our analysis, but the positive exception of a job special of “BRAVO” magazine could show that it is possible.

Regarding one of our main research questions about if and how SET images are gendered, we can state the following: Positive news are, we found various gender equal representations of science, engineering and technology. The negative thing is that those images represent SET very often in an unrealistic manner, using technological artefacts as accessories and not in a real, meaningful technological context.

References


