Attracting teenagers to engineering by participatory music technology design

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Abstract

This paper will present first results of the research project „Engineer Your Sound!“ (EYS; 2008-2009) funded by the Austrian Federal Ministry of Science and Research. EYS explores the potential of addressing young people's interest in music and music technology in order to raise their interest in technology and engineering. The project aims at developing didactic concepts for installing gender-inclusive technology education in Austrian high-schools. At the SEFI conference, first results from pupils' work in their music technology projects will be presented.

Keywords Science & technology education, gender, music technology, curriculum design, participatory technology design, upper secondary school

1. INTRODUCTION

The European Commission has announced a crisis regarding young people's lacking interest in science and technology related careers (EC 2001). Unattractive and difficult science education in schools has been identified to be the main reason (EC 2007). The international PISA-study could show that pupils have little possibilities to test their ideas, to set up experiments and to explore scientific knowledge in real life situations (not just in Austria; Schreiner 2007).

School and university students are more interested in interdisciplinary technology and various digital media than in mono-disciplinary technology topics. Moreover, interdisciplinary technology settings attract a broader range of students, both male and female, with a wider set of interests and talents. This has been proven by two Eu projects INDECS and WomEng (Wächter 2005).

The EYS project transfers this knowledge into didactical practice. Teenager's music interests are taken as a starting point in order to raise – boys' and girls' – interest in technology. Music technology is a classically interdisciplinary field of technology, which affiliates to youth relevant interests (Martig 2006; Rhein & Müller 2006).

Music devices are the main group of electronic devices owned by teenagers in Germany (Medienpädagogischer Forschungsverbund Südwest (2007). Music TV shows like "Pop Idol" in Great Britain, "American Idol" in USA, "Starmania" in Austria, "Deutschland sucht den Superstar" in Germany, "Nouvelle Star" in France, but also popular music video games (like the karaoke game "SingStar" or the simulation game "Wii Music") and computer games (like the editing game "Make My Video") symbolize the importance of music especially for young people. Moreover, music has a high potential for "self socialisation" as well and for many teenagers it is one of their main areas of interest and activities (Rhein / Müller 2006). Another important point of music is that it has been identified as unisex interest field among young people (Großegger 2005). This should be a major advantage of music as an application field comparing to various other "heavily" gendered technology fields like for instance automobile engineering.

Based on those facts, our hypothesis is that teenagers` interest in music can drive boys and girls into engaging with technology (Schuegraf 2008) The accompanying research of the participatory project EYS focuses on exploring and

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analysing the potentials of music technology as an interdisciplinary field of technology that not only relates to teenagers' life world but also enhances general technology interests.

EYS aims at both exploring and designing school classroom curricula for physic and music education. The idea is to try out and design interdisciplinary, innovative teaching/learning settings in which relations between music and technology can be explored in order to give pupils opportunities to experiment and to discover their technical potentials, skills, interests and talents and to present the field of technology and digital media as an appealing career option.

2. ENGINEER YOUR SOUND: THE CONCEPT OF THE PROJECT

The idea of the EYS project is to test whether interdisciplinary, innovative teaching/learning settings in the field of music technology can be used to give pupils opportunities to experiment and to discover their technical potentials, skills, interests and talents and to present the field of technology and digital media as an appealing career option.

In the project, 20 female and eight male pupils deal with participatory technology design processes in cooperation with sound engineers, computer musicians, and physics and music teachers. At the project start, in October 2008, the pupils were introduced to various fields of music technology, electronic composition, body and computer interaction, sound production and engineering, computer-supported choreography, etc. The pupils should get ideas to realize their own creative ideas, for example, compose and produce technology-based or -supported music using state-of-the-art technology; which were collected and discussed in a first workshop in school.

In collaboration with a sound-engineering master student, who studies at the Technical University and University of Music and Dramatic Arts Graz, as well as with their music and physics teachers, high-school students are currently developing their music-technological projects. The sound-engineering student is definitely a role model for the teenagers as well; she herself is educated in music and technology.

EYS is embedded in an extra course of physics and music. That means, pupils work on their projects and reflect on them in both classes in school. Beside that teenagers work in recording studios at technical university and meet in their leisure time to advance their technology projects. Further discussion and some sort of public relation work about the design processes and outcomes are enhanced via a "weblog" (see http://eys.twoday.net). Using all these project parts and technology arenas, the girls and boys can become aware of their implicit technical knowledge and their tacit design and engineering skills, e.g. in the IT and (music) media realm. Pupils in such an empowering experimental setting thus can become music technology experts and consequently can support their teachers in the education process (as has been shown for other contexts by Meyer 1997)).

The students are not only asked to design music artefacts in EYS, but they contribute to the second research aspect of the project as well: Modernizing methods and topics for science and technology classes in upper secondary school level.

The overall aim of EYS is to develop teaching concepts for installing technology-related music projects in other high-schools. The participating pupils, with their music expertise, partake in the didactical design of such concepts, drawing on their peer experiences of teenagers' life-world related musical interests. Therefore they cooperate with music engineers, electronic music composers, education scientists, gender researchers, and teachers.

The research references of the participating teenagers are thus threefold: They relate to music, technology and pedagogy.

3. METHODOLOGY

The teaching and learning process is carried out by all project partners: The University of Arts in Graz, the IFZ Graz, the University of Landau, the teachers of the participating music-focused high school, and the 28 high school students. Those students are between 17 and 18 years old and they are music experts, having several years of experience with at least one musical instrument.

The action research concept (Gilmore/Krantz/Ramirez 1986, Lewin 1947, McNiff / Whitehead 2002) implies that teachers and pupils are at the same time involved as actors and researchers. Teenagers' low interest in technology-related education is often associated with science and technology classes which do neither relate to teenagers' everyday lives and nor use hands-on approaches (European Commission 2007).

As opposed to other empirical research concepts, in action research the definition of the problem can be altered continually in the course of the research process, as new insights are gained. The boundary between the researched persons and the researching persons, which is geared at obtaining objectivity – as emphasized especially in quantitative standardized study designs – is replaced by aiming at obtaining validity for the respective target group.

In EYS, we take the action research approach even one step further and relate it with principles of the participatory technology design approach, which aims at integrating relevant stakeholders into the design process (Ehn 1993, Schuler/Namioka 1993). Moreover, in the approach used in EYS, students are seen and involved as experts.

In so doing, EYS' action research approach follows the tradition of so-called critical-constructivist education: Klafki speaks of an emancipatory interest in knowing (in German "Erkenntnisinteresse"), which should be geared at in teaching (Klafki 1976). Teaching and learning will as such extend an „education for practicability" (Gruber 1997 calls it in German "Bildung zur Brauchbarkeit") and enables participants to perceive their learned knowledge and competencies as sustainable and as empowering beyond school grades or factors like employability (Gruber 1997).

As technology can be understood as a heavily gendered field, with an underlying sub-text resulting from social constructions of gender and technology, the gender dimension is addressed in EYS on many levels: The research team consists of men and women; the technology coach for the pupils is a female sound engineering master student. The group interactions in EYS workshops and among pupils are monitored with a gender perspective.

The project is especially designed regarding former results of studies and suggestions on how to overcome the gender gap at engineering degree courses (Thaler 2006, Thaler & Wächter 2005, Thaler & Wächter 2006, Wächter 2003). These guide the concept of participatory methods in technology design and in the implementation of the action research process.

3.1. RESEARCH QUESTIONS

The EYS project puts an action research approach into practice that aims at setting up new didactic scenarios and evaluating their outcomes and potentials as well. The realization of the participatory technology project has the following research questions:

3.1.a. How can music technology become an entry gate to introduce technology fields to teenagers?

3.1.b. How do boys and girls perceive, approach, and invent music-related technology design activities?

3.1.c. How can a learning-by-teaching approach be successfully installed in regular high-school classrooms?

3.1.d. Can music technology serve as a so called gender-neutral field for technology-education?

3.1.e. How can interdisciplinary technology education in school support young people in opting for technology degree courses?

3.1.f. Can technology-related self-efficacy be enhanced through EYS? (Bandura 1997, Hackett 1997).

4. PROJECT IMPLEMENTATION

For the participating students, teachers, music technology coach, gender and education scientists, EYS has four main phases:

Phase 1: Getting to know the field of music technology;

Phase 2: Shaping own technology designs;

Phase 3: Developing didactical models in the field of music technology;

Phase 4: Presenting technology products and didactical concepts.

In phase 1, the 28 pupils made an excursion to the Institute of Electronic Music (IEM) to get an overview of the variety of music technology. Beside more typical parts of sound engineering like a recording studio and an audio engineering studio, the researchers of IEM presented also their current scientific research („Embodied Generative Music", see: http://www.embodiedgenerativemusic.com). This electronic musical research takes place in the so called "cube", an aesthetic lab with gestural interfaces. The cube installation allows translating movement into sound via infrared sensors. The students could experience this impressive installation in various ways by trying out movements, playing with an ball with sensors or dance and "composing" music by doing so. The aim of this first excursion was to

broaden their understanding of music technology and electronic music. Their interest was sparked indeed, as is indicated by the number of all 28 pupils who – after the excursion – decided to take part in the EYS project.

In the kick-off-workshop a multilevel, associative brainstorming process – containing also music technology presentation elements – led to five teenagers' groups with different music technology projects.

As of the date of writing this paper, the project is in phase 2: All groups work closely together with the sound engineering master student, their physics teacher, and one education scientist on their own projects.

The first group develops so called "air instruments" with refined "Wii"-technology (originally produced by Nintendo). "Wii" is a home video game console with a wireless controller, and currently one of the most used game consoles among young people. The second group composes their own music and alienates it with "Vocoder" technology. Vocoders (*voice* and *encoder*) are electronic devices which were developed for military telecommunication, to code and decode human voice for transmission in radio communication. In EYS, vocoders are used as electronic music instruments. The third and fourth group produce own short movies and compose electronic music for them. While the one group aims at providing movie scenes with the best fitting music, the other group wants to prove their hypothesis that film music is mainly influencing the emotional perception of the movie. The fifth group has an ethnographic approach participating and documenting their peers and producing a documentary movie about this part of the project EYS.

The next phases of EYS will be carried out until July 2009. Based on the experiences of the participating pupils didactical models will be developed in close collaboration between the teenagers, music technical and educational researchers. Finally, pupils' will present their projects and results in a public event. And didactical models for science and music classes will be disseminated.

4.1. Accompanying research

In addition to previous mentioned core topics of EYS, the authors of this paper do various accompanying research to answer general and specific research questions (see therefore 3.1). These research activities comprise the following:

- Quantitative evaluation
- Qualitative evaluation
- Gender research

The quantitative evaluation takes place from start to end (phase 1 – phase 4) and mainly analyses data from a pre- and post-survey which will be done through a standardized questionnaire. In the centre of this part of the quantitative evaluation stands our hypothesis that connecting technology to music will increase interest in technology. Students filled in the questionnaire the first time, when they made their first excursion to t he Institute for Electronic Music, in October 2008. Questions covered the excursion itself, students' career visions, their possible future study majors, their experiences and interests in technology and their IT-related self-efficacy (see research questions 3.1.e and 3.1.f). At the end of the project, in July 2009, students will answer the same questions (except the excursion-related) in a post-survey. Additionally students answered another questionnaire, exploring their communication media. This questionnaire aimed at the research question whether teenagers with that special music competence and activities use for instance same internet media like their peers in Austria or if they have special – maybe audio-focused – communication channels.

The qualitative evaluation accompanies the whole project as well and mainly bears on an ethnographic approach containing also document analyses. The methodology comprises in detail, participating observations combined with interviews in workshops and pupils' group meetings during the technology design process and during phase three (developing didactical models), and analyzing material (photographs of flip charts and chalk board writings, weblog entries, etc.). In that way, the qualitative evaluation can complete the quantitative research in order to learn not only about the effectiveness but also about the modes of connecting technology to pupils' interests in music (see research question 3.1.a) and the transferability of the EYS concept (see research question 3.1.c). And moreover, we can find out how technology design ideas are progressing and changing along the design process, for instance as a result of certain interventions during workshops (see research question 3.1.b).

The gender research is based on an action research and ethnographic approach as well and constantly analysis all activities from phase 1 to phase 4 (see research question 3.1.d). Observations are permanently reported to involved coaches, teachers and scientists, in terms of continuous feedback about important issues and potential improvements.

The project and its accompanying research, analysis and interpretation of the results will approximately be finished in October 2009.

5. EXPECTED OUTCOMES

EYS has different expected outcomes for the different cooperation partners.

For the teachers of the participating high school EYS can bring insights and involvement in current research. They can learn about the field of "youth, gender and technology", about innovative teaching methods and didactics, practical relevant references to their subjects and further education in music technology. Beside that we assume that their relation to the pupils will benefit, most notably because of the pupils' role as experts.

For the participating students we expect that they perceive themselves as technological competent, that they broaden and deepen their technology competencies and that their IT-related self-efficacy will be strengthened. The participatory technology design approach plus the philosophy of EYS to see teenagers as experts should rub off on their overall self-confidence and make technology-related job- and study-decisions more probable.

And for us education and gender researchers in the team, the chances are to experience applied interdisciplinary research, to accompany a group during their technology design and learning process, to not only test theories and concepts in practice but moreover to use continuous feedback to improve the project idea and develop the concept permanently, and last but not least to receive internationally relevant answers to questions of how pupils' interest in science and technology can be raised. Another side-effect could be to explore new potentials of existing technologies, as the experiments of some students groups with the "Wii"-technology and their "air instruments" may show.

6. CONCLUSION

Although technology-related careers are expected to offer great professional opportunities, a decline in young people's interest and especially low numbers of female students in science and technology have been stated (European Commission 2001, European Commission 2006). The presented research project "Engineer Your Sound" (EYS) is based on well known facts from previous studies, like students' higher interests in interdisciplinary technology topics, need of new didactical approaches, especially girl's lack of technology-related self-efficacy and bearing in mind teenager's interests. Therefore EYS connects technology to music, which is a youth interesting topic, in order to present the field of technology as an appealing career option.

EYS works as a cooperation project between music and physics teachers, education scientists, gender researchers, a sound engineering master student, an electronic music composer and researcher and 28 music-competent high-school students.

In the first part of the project, the pupils realize their own creative music technology ideas, for example, composing and producing technology-based or technology-supported music using state-of-the-art technology. After that phase, they will contribute to the second research aspect of the project as well: Optimising contents and didactics of science and technology classes in upper secondary schools.

First results can answer some of EYS' research questions coarsely but promisingly. We can reason that music technology could indeed be an entry gate to introduce technology to pupils by consequently using a participatory technology design approach. This means, using teenagers' ideas and finding a balance between support and autonomy.

The achievement of the overall aims of the project – the development of technology-related didcatical concepts for other high-schools and the raise of the participating girl's and boy's technology interest – will be assessed after the finishing evaluation of EYS in autumn 2009.

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