Identifying relevant CS contexts using the miracle question

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ABSTRACT
The context-oriented approach for teaching CS\(^1\) wants to provide a framework to design teaching units that paint a more interesting picture of CS and show the relevance of CS in the students' everyday life. Our approach for identifying and preparing interesting contexts for children is divided into three steps: First, we start from the IT systems children and youths use every day to get hints for a suitable context. Second, we use a variation of the so-called miracle question to narrow and sharpen the focus onto that context. For the analysis, we use qualitative content analysis following Mayring. Finally, the categories we found are analyzed regarding the use for preparing material to ease the design of teaching units for CS in context. We report from our study with 130 children and the analysis of their questions along the context "mobile phone".

Keywords
CS in Context, Informatics in Context, mobile phones, miracle question, qualitative study

1. CS IN CONTEXT
"CS in Context" is a derivation of other context oriented approaches as "Chemistry in Context" and "Physics in Context". They were set up after the criticism on the German school system that occurred after the results of the PISA test in 2003 and they all aim at the improvement of teaching these subjects at secondary schools to rise the motivation for natural sciences and to develop "scientific literacy", see [5]. CS in context seems to be a promising approach to raise the interest and motivation for Computer Science at school, see [2]. One major aspect of this approach is that students’ questions about a certain topic lead the teaching process. As a consequence to this teachers have to be prepared for the questions students may ask. However fast changes in computing technology render this to a challenging task and becomes quite hard for a normal CS teacher to stay up to date, especially for those teachers who have not studied CS.

A context can be defined in different ways, see [5]. Our working definition of a context starts from phenomena and is the following: Some phenomena form a context if they can be traced back to the same subject matter and concepts. A phenomenon is something that can be realistically or imaginatively experienced.

According to a constructivist point of view on learning, everyone has a different perception of a context relying on the perspective, different experiences or education. Therefore we have to find out how a certain group, i.e. our students, thinks about that context. To find contexts that are relevant to them we should start from their everyday life. Studies like the German JIM-study [4] where children and youths are asked about their daily use of media and computers show that they spend a lot of their time with information technology, more precisely with technical communication media like mobile phones and all sorts of messaging. Thus, a mobile phone should be a quite interesting and motivating context for them. Other contexts that can be derived in that way from these studies are: email and chats, video streaming or music downloads.

A context, e.g. "mobile phone", is very complex and has many different links to CS that can be used. For the development of teaching material it is necessary to limit the context to those aspects that are most relevant to the students on the one hand and most useful for CS lessons on the other hand.

2. RESEARCH FOR QUESTIONS
When students are asked about their interests regarding to a certain topic like mobile phones they ask very few questions. They seem to be bit overburden by such an open task. This reaction can be noticed e.g. in science classes as well and might be caused by the following: When a teacher asks students about their thoughts according to a certain topic or what they would like to know about it, they expect work for them in most cases. Students also hold back their questions due to the fact that they feel to be accountable for the answers. Questions they think that might be too hard or impossible to answer (for them) are not asked.

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To find a solution for a problem in therapy the question would be: "Imaging - after you go to bed this night a miracle happens and when you wake up tomorrow morning your
problem has gone. How would you notice that it’s gone? What would be different?” and “Who else would be the first to notice that it’s gone?”, see [1].

One of the main effects of this kind of questioning is that the miracle question frees the patient from the responsibility for the changes that lead to the noticed differences or the solution of the problem.

To find out which aspects of a mobile phone are interesting to students of lower secondary schools, we designed a survey with 130 students - 54 boys and 76 girls - aged 10 to 17 from different schools and different regions in Germany. Some students live in a rural landscape and some live in a big city, some have lessons in CS as a regular subject, others do not. This design should lead to a representative set of samples.

Our question was (in addition to age and sex):

Imagine - You meet an expert for mobile phones who knows really everything about it. You can ask him any question you like. What question would you ask?

All questions they wrote down were transcribed and analyzed using qualitative content analysis following Mayring, [3]. This kind of analysis is often used in educational studies. The data collected e.g. in interviews or open questionnaires like in ours should elicit and reflect what people think and feel.

3. RESULTS OF CONTENT ANALYSIS

Due to the open design of our survey we got questions from all sorts of topics regarding mobile phones. Some of them are rarely usable for designing CS lessons and some are quite interesting and surprising:

Typical questions for the first five categories are the following (# total/ % / male / female):

- **best phone (22 / 16,92 / 12 / 10):** Which phone is the best on the market now? Has my phone a good value for money?
- **radiation (18 / 13,85 / 8 / 10):** How dangerous is the radiation dose of mobile phones?
- **contract (13 / 9,23 / 6 / 7):** What’s the best contract for me? Why do I have to pay if I’m in another country and someone sends me a short message or calls me?
- **future (10 / 7,69 / 3 / 7):** What will we be able to do with mobile phones in 10 years?
- **basic functions (8 / 6,15 / 3 / 5):** How is a mobile phone working? Of which technical parts does it consist?
- **Bluetooth and infrared (7 / 5,38 / 2 / 5):** security and localization (6 / 4,62 / 0 / 6), history of mobile phones (5 / 3,85 / 4 / 1), general questions (4 / 3,08 / 3 / 1), number of mobile phones (4 / 3,08 / 2 / 2) and a few more.

According to the JIM-study [4], we expected more questions regarding photography but this topic was only mentioned in two questions. In contrast to this, we did not expect many questions to the topic risks of radiation but 14% of all questions addressed this topic and therefore it forms the second largest group of questions. Moreover, questions regarding the security and localization of mobile phones have only been asked by girls. All other topics are more or less mentioned equally often by girls and boys.

With these categories, we now have an insight on the wide range of students’ questions regarding mobile phones that may come up in class. We have to decide which of these categories are relevant for CS in context teaching units. This decision cannot be made by hard criteria. But we can connect the questions to educational standards and curricula.

To provide only a first orientation for further work we split up the categories into three groups regarding their possible use for a certain phase of a teaching unit for CS in context:

1. **for the phase of contact, to rise motivation (general questions, history, risks of radiation, future of mobile phones)**
2. **for the curiosity phase to structure the elaboration phase (functional design, transmission via radiation, security and localization, Bluetooth and infrared) and**
3. **questions with few relevance to CS lessons (best or most expensive phone, best contract).**

4. CONCLUSIONS AND FUTURE WORK

Our analysis of the students’ questions shows that the 130 students we asked were very interested in mobile phones, almost 40% of the questions can be used for motivation and introduction but only a quarter of the questions may be used to work on CS issues. The questions of the second group aim at relevant CS content and were mostly asked by girls. This group is the one with most usable questions for CS lessons. Due to the fact that this is a qualitative study, we can only regard this as hints for planning CS lessons and future work.

The analysis of the questions we got by using the miracle question could be augmented by the development of a criteria system that allows to discuss the use of questions from certain categories more reliably. These criteria should allow to decide how important a set of questions is to work on a certain CS topic.

Altogether, we think de Shazer’s question has great potential for eliciting information from students in a non-threatening way. And we hope that this approach and the questions raised by the students in this study are something that could be built upon by other researchers, also.

5. REFERENCES