Computer Biographies - A Biographical Research Perspective on Computer Usage and Attitudes Toward Informatics

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ABSTRACT

We suggest a research instrument which gathers individual biographical developments of students with respect to their attitudes toward computer usage, their experiences with computers and learning computer science at school. Students simply write down their personal experiences with computer usage, how they remember their first contact with the computer and the role of computer science as subject at school. Computer biographies are narrations of one's own computer usage biography.

Students' experiences, their computer biographies, strongly affect (initial) understanding of computer science. We want to understand how, based on individual preconceptions, students incorporate the introduction in computer science into their conceptual framework and how biographies develop. The research is aimed at supporting assessment of students' conceptual understanding of the discipline and a prerequisite for teaching concepts supporting conceptual change. First results indicate peers, learning strategies and role of school as important factors.

1. INTRODUCTION

Students computer usage, their previous experiences (including mobile phones and other electronic devices) have impact on their abilities, interests and attitudes [3, 5, 8, 4]. In short, experiences in computer usage influence preconceptions of computer science.

From the perspective of pupils or novice students computer usage plays an important role. Humbert [6] reports from studies with high school courses (grade 11), that at the beginning 80% of the students describes computer engineering as the science of "applying and using the computer". But, after attending one year computer science as subject at school, strongly aimed at teaching an appropriate understanding of the science subject, still about 60% of the students thought so.

This shows the difficulty of changing students' preconceptions of the discipline. Another example is the underrepresentation of woman in computer science: although research revealed many reasons, it is quite stable since over 20 years [2].

Students' preconceptions are formed outside school mostly. We can not assume novices thoughts about and beliefs in the new subject matter are like 'blank pages', ready to gain new insights from scratch. Instead even freshmen come to class with prior knowledge, attitudes and expectations. Moreover, the new information and facts taught in class interact with this initial understanding of the subject matter. Therefore, successful teaching needs to take into account students preconceptions [7].

Moreover, preconceptions are likely to depend on the actual technology, so e.g. the "Nintendo generation" might have different interests than earlier generations [3].

In other words, it may be that students come as novices to computer science courses in school, but with already quite stable beliefs in the nature of the discipline. In order to be able to introduce novices more successful into computer science, it seems valuable to gain more in-depth insights into the nature and the development of these preconceptions.

Because they are results of individual biographies, we intend to conduct research on the computer biographies of students.

2. BIOGRAPHY AS A METHOD

Research has already revealed many influence factors, like e.g. gender, math grade, role model, prior programming experience, self-confidence, and so on. But addressing one (or some) of these factors might not be sufficient to change students general understanding of computer science or to improve the effectiveness of teaching.

Instead of revealing more (singular) influence factors we aim to understand students' preconceptions, their conceptual framework of the subject matter and how it evolved.

Biography as a method is an approach from qualitative social research. Biographical material like letters, diary extracts or individually told stories are the basis for this method which raises the issue of how to link privately based experiences to more publicly based forms of knowledge and understanding. The biographical method approaches the coherence between the personal perspective of the individual and its social relativity.

It is not the aim to prove the influence of a certain factor like math grade, but rather to explore how the biographical development of a person forms a coherent framework of interacting factors - leading to, or building a certain understanding of computer science.

We suppose that knowing some typical biographical developments and their underlying patterns supports the development of teaching concepts for novices. Such teaching concepts should allow teachers to respond more precisely to students' preconceptions.

In order to gather the needed data we try to use a concept we call *computer biographies*. It is a method we adopted from research on literary socialization [1]. It simply means that students write down their personal experiences with computer usage, how they remember their first contact with the computer and the role of computer science at school.

Thereby we want to take into account influences of experiences outside school, namely computer usage, but also the role of school. We want to understand how, based on individual preconceptions, students incorporate the introduction in computer science into their conceptual framework.

Computer biographies are narrations of one's own biography - not the biographical development itself. Therefore the data has to be reconstructed. For example, it must be taken into account that respondents might try to construct a personal biography they believe it is wanted or generally accepted. So women might stress their deficiencies in computer usage while men might disrespect one's own learning difficulties. There are techniques to support such reconstructions. But nevertheless such biographical data needs in-depth interpretation of every single file.

So one might ask, why not rely on surveys or interviews instead? Firstly, instead of examining a given set of influence factors we try to find such factors. We are interested in finding unforeseen patterns, interesting biographies that might be useful as a kind of role model for the construction of teaching concepts. And we want to take into account technological advances and the probably increasing amount of computer related activities outside and before school (We assume that school does not start at the beginning of the biographical development, nor is the only factor influencing this development). The proposed instrument allows being open to individual answers, while enabling the researcher to point to areas of interests, that might be overlooked. The technique is simply to give the participants some examples of computer biographies. Thereby the intended type of answer becomes clear. And the researcher can hint to some aspects of interest. In our case we give examples in which students mention their experiences with computer science at school.

Instead of written computer biographies it would be possible to use interviews instead. Interviews allow the researcher to interact with the participant, e.g. to clarify obscurities in the answer. While they are more flexible, they are also costlier. Moreover, inquiries of the researcher might even disturb the narrative process. Using the written form can create a subtle pressure to 'tell the whole story'.

3. FIRST RESULTS

In a first approach we accomplished a preliminary study with 70 university students. The largest part of the participants was born between 1980 and 1984. 31 participants attended studies in computer engineering, while the other 39 students pursued German language and literature studies. We provided them with so called "lure texts" we assembled from biographies written by a small group of graduate students from our own class. We asked the participants to read the "lure texts" and to exemplify them writing their own biography. We performed this experiment during students' class and restricted it to 30 minutes, which we figured out afterward is not enough time to give a more detailed account. Nevertheless, we could detect interesting facts and correlations which sustained our assumptions.

In the following subsections we present some initial results of our examination (quoted text samples are coded the following way: year of birth, gender, number and subject (U1 stands for computer engineering and U2 for German language and literature studies)).

3.1 The first contact and learning strategies

Vast majority of participants reported, that computer games initiated their first computer contact. Furthermore they continue to spend much time in front of a computer because of the computer games. Very often this first contact comes along with family members and friends: *"My first contacts with a computer were due to my* ***brother*** *who engaged very early in computer games.* ***I played simple computer games with him.****"*(80f4U2) A family member established the first contact and computer games kept her motivation to go on.

In this phase the computer is perceived as a platform for games, and not more. This way, the participants learn playfully and intuitively to handle a computer. When it comes to work with it, they already know how to use it, for example how to turn it on, to install an application or to use a program: *"****I always loved to play****, with dolls, cars, cards or other games. When we got our first games console, nobody could get me off the TV, this is how much I loved this kind of game.* ***When we had bought our first computer I quickly got people to show me how to install computer games.****"*(83f28U1) By the way this student mentioned, that she learned to install programs. It seems, this ability is not a special computer skill for her but just a means to an end helping her to do what she loves, like shuffling a deck of cards.

The most part of the participants conceptualize their learning strategy as a kind of "learning-by-doing" and "I learn myself". We could distinguish fine graduations between an active and passive learning strategy:

The first "I taught myself"-version sounds very active and independent: *"As nobody had a clue about PC's,* ***I simply taught myself.****"*(82m22U1) The participant describes himself as a person with strong self-confidence in the ability to master the demands of computer usage.

The next student describes his learning as a (quite short) way from being taught to self-reliant learning. At first he learned in a passive way and later tried to find out the solution on his own: *"Initially* ***my father taught me first*** *how to handle a computer, later it was* ***learning by doing****."*(83m14U1)

A third type describes that learning as neither self-reliant nor dependent, only: *"[...] how to handle a computer. I partly* ***taught myself*** *or was shown by my* ***mother****."* (85f9U2))

In summary, some students see themselves in an active (self-reliant) role and other in a passive (dependent) role. Mixed modes of learning were also found.

Based on assumptions of situated learning it seems likely that students unconsciously apply the same learning style in the computer science lab at school. While some are eager and self-confident to solve exercises on their own, others implicitly expect to be guided by the teacher.

The question arises, how students will response to teaching not designed accordingly to their learning strategy and how teachers react to the preformed different learning styles, respectively.

3.2 Expectations toward the computer science class

We figured out two groups in which the expectations toward computer science class are diametrically opposed (similar [8]).

One group is interested in programming, while the other is interested in learning more about appropriate computer usage, disregarding the interests of the other groups. Note, that this is quite distinctive, since e.g. compared to math education the most striking difference concerns interest in the subject matter, but here we have opposed groups with both high interests in the subject matter.

Students belonging to the first group choose a computer science class at school because they want to become competent computer users. They expect to learn how to use common software like Word or Excel and the Internet, and how to install and maintain hard- and software: *"Then, in the 9th grade, I chose the computer science course. There we learned the* ***different computer languages and how to program****. However, this was not what I expected of the course,* ***because 90% of it was not realistic****."*(80f4U2)

"[...] ***due to my lack of expertise in this field*** *I chose a computer science course in the 11th grade. I thought we would get* ***useful information for the everyday usage and for handling different applications****; instead we had to learn how* ***to program, something that was not interesting + boring as well as very absurd****."*(80f25U2)

These students are an example of a type interested in learning computer usage. She is not able to appreciate the learning objectives of programming' and therefore conceptualizes the subject as not interesting and boring. She expresses strong negative emotions.This might be a honest evaluation on the one hand. On the other hand: It indicates that maybe deficiencies in computer usage (compared to class mates) affect her ability to understand the learning content. Or, to put it in other words: Using the tools is a great distraction for this type of student.

Moreover, this kind of distraction can be the source of negative attitudes toward the computer:

"Then, in the 10th and 11th grade, I had to attend computer science courses. It was hell, because ***nobody explained the computer, instead we had to write programs****. I was always* ***afraid*** *that by touching any button the computer would explode or at least break down."*(77f1U3)

Regarding this aspects, interviews with computer science teachers in secondary school [6] are interesting: Regarding usage of tools and development environments teachers answered that they are not willing to pay attention to support students in using the tools. It seems, that thereby some types (or group) of students are becoming frustrated. This is especially important in context with the different learning styles of novices. It may be that some types of students are discriminated in multiple ways.

A striking property of this group is the large quantity of female participants. Biographical studies are not primarily aimed at quantitative results, but regarding gender aspects the findings reported in [2] are matched.

Students from the second group are already competent computer users. They expect to deal with computer science, software engineering and to learn programming. *"When my mother finally bought a computer I handled it surprisingly quickly. After having explored all* ***easy functions (Word etc...)*** *I came upon building websites and I engaged in HTML. When my school offered a computer science course, I was immediately interested in it. But the course was* ***very disappointing****, because I already knew how to turn a computer on...* ***I had to carry on exploring this field by myself****."*(87f11U4)

The computer science class of this participant was most likely more appropriate for students of group one. She is also a learning-by-doing type—another characteristic of this group.

"The computer science course at school was ***rather disappointing****, because it was only offered in the 7th grade and than later as an optional course in the 11th/12th grade,* ***not very much, isn't it?*** *The topics (text processing, Delphi, data bases) were more designed for people who* ***dealt with a computer for the first time****."*(85m3U1)

"In the 8th grade we did something with data processing and in the 13th grade I attended the optional computer science class, but I found both ***rather ridiculous and I was always much ahead of the teachers****. Therefore, I was fairly bad at school and experienced it as something which steals the* ***time I need for programming****."*(81m24U1)

That a student's knowledge exceeds that of its teacher is a quite unique phenomenon of computer science courses in secondary school. This fact partly originates in the short lifecycles of todays technology which makes it hard for teacher education to keep up. On the other hand there are still lots of computer science teachers which were originally trained as teachers for different subjects. After years in their "old job" they did further training to become a computer science teacher. It is not astonishing that kids spending hours in front of the computer every day for years master the subject with ease while their teachers behave clumsily.

In summary, this type of research affects teacher education, too. For the most part results should help teachers to diagnose and assess students' understanding of the subject matter as well as their attitudes and emotional involvement toward the subject. This aspect is addressed further in the following section.

3.3 The role of school

During our research it became obvious that so many students were dissatisfied about the role of the school because their expectations of computer science class were not fulfilled and only a minority reports positively about the computer science class.

It seems that nether the experienced group nor the inexperienced group was satisfied with the subject at school. Although we gathered positive evaluations from each group, the majority was disappointed with the role of school in their computer biographies.

The freshmen report that they did not learned how to use a computer. Instead they were forced to program. More experienced students report that the course was boring and not interesting: *"Altogether I wish my computer science course at school had been better.* ***It disencouraged that the teacher knew so little****."*(82m22U1)

"Initially in school I attended my first computer science class when I was 15. The teacher had more ***to learn from us than to teach us****."*(83m14U1)

Yet we know that many teachers ask their students in the beginning of a computer science course about their experiences and their expectations. Still the students are disappointed. We suppose, the teachers try to strike the balance between this diametrical expectations but fail because the existing didactic concepts are probably not helpful enough.

According to the quite negative evaluation of the role of school, the role of peers like family members is valued in sharp contrast:

"From the side the school enthusiasm for computer science ***was not at all promoted. My father was the decisive factor*** *(he also works in this field)."*(81m13U1) *"However, at school* ***I did not learned how to handle a computer****."*(85f9U2)

It might be that many of these issues simply are due to the education system in Germany: There is no subject concerned with computer usage. Instead computer literacy courses in lower secondary level are (in most schools) optional. Computer literacy for all students then should be taught with the so-called integrated approach: Teachers are invited to incorporate issues of computer usage in their subjects. But nevertheless in upper secondary school, where students can enroll to the subject computer science, usage issues are handled as prerequisite.

4. CONCLUSION, PERSPECTIVE

Students' preconceptions comprise many influence factors, including computer-related learning styles, expectations and beliefs in the nature of computer science. It might be that the classroom situation resembles so much of the private situation of computer usage that these preconceptions endure. On the other hand, there are many students mastering the conceptual change from computer usage to a more scientific understanding of the field.

Computer biographies may help to clear up understanding of successful biographies and thereby supporting teachers in assessing their students' learning needs as well as supporting the development of teaching concepts with regard to individual biographical differences.

With this preliminary study we want to provide a basis for a research project exploring the assessment of students' conceptual understanding of the discipline and developing a prerequisite for teaching concepts supporting conceptual change.

Therefore we plan to collect more biographies from students of different study fields. The comparison of biographies of people enjoying computer science with biographies of people hating computer science will help to understand students' preconceptions and their conceptual framework of the subject matter and how it evolved.

We also plan to quantify our data by coding them according to grounded theory. Our long term objective is to accomplish our study over a long period of time to filter the aspects changing with technology from the constant aspects which are important for us.

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