A Didactical Look at the History of Informatics

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Abstract

Starting in the early 1970ies, teaching the subject informatics at schools has undergone a very dynamic development. Hence also in Austria's secondary schools which provide general education the discipline informatics has been exposed to multifaceted influences and didactical approaches. So far, the view of informatics as a necessary part of general education has been widely accepted. But informatics as a subject is still far from being consistent and consolidated, even in consideration of its learning objectives. We may assume that by now historical aspects in informatics lessons play, if at all, an inferior role.

In this paper we try to give reasons for dealing with informatics history at schools, i.e. introducing historical aspects into informatics teaching and including informatical issues in history classes as well. Furthermore we make suggestions to establish a historical approach for the future of teaching informatics in Austrian schools, preferably in an integrative way.

The computer programmer is a creator of universes
for which he alone is responsible.
Universes of virtually unlimited complexity
can be created in the form of computer programs.
[Joseph Weizenbaum]

Informatics systems and the changing society

In a view of the late 1990ies Manuel Castells states that „...while technology per se does not determine historical evolution and social change, technology (or the lack of it) embodies the capacity of societies to transform themselves …" and furthermore that "…society cannot be understood or represented without its technological tools." [5].

Informatics systems represent one of the leading technologies of our time and anybody who is part of the computerised society is – to a certain extent – affected by its benefits and pressures, either due to the transformation of work and employment or the "culture of real virtuality" [5]. The latter does not only reach into privacy but sometimes dominates it. This holds true especially for the young, the rising generation, which increasingly uses devices for virtual communication as the main socializing tool.

Clearly enough, this situation didn't grow out of nothing. Informatics boasts at least 50 years of development, accompanied by speeding up changes within society. This shall be illustrated by a few examples concerning work: The second half of the 20th century saw the rise of data-processing machines facilitating office-work, the introduction of computer aided manufacturing systems, replacing men and women doing assembly-line work or the ongoing infiltration of the scientific community with information technology. All of these innovations have been triggered by technological inventions, which all together led to a shift of public consciousness due to a changed perception of everyday life. Being at the core of these innovations, information- and communication- technology influenced society as a whole.

Therefore dealing with history of informatics, the basic science of all IT-developments, is essential to understand the conceptual, technological and historical changes so far. Consequently, pointing at the evolutionary interdependency between society and technology will be necessary to enable young people to understand and to question their everyday real live and virtual reality.
In other words: Tomorrow's society needs to know about the history of informatics to reflect upon technology and to influence further technological development for the better.

> The claim of General Education is that
> the history of science is part of science.
> The contribution of science instruction
> to the life of the university and to society
> should include these elements,
> since science includes them...
> [Harvard committee on general education]

General Education in a Broader Sense

The concept of general education dates back to the 17th century when Jan Amos Comenius designated the target that "everything must be taught to everyone" [11, 23]. This idea was taken up by humanistic pedagogues like Wilhelm von Humboldt, who saw education as the means for the emancipation of the classes, and it was adapted in the mid of the 20th century to meet the requirements of modern times. No longer general education was solely based on conceptual knowledge, but included pragmatic and social competencies as well. It was the information age which demanded another shift in the focus of general education. Retrieving information, rating information, combining information and presenting information became vital for the network society.

That was the time when the subject informatics was added to school curricula in order to contribute to general education. To be able to do so, the informatics didacts established a framework of leading or fundamental ideas [2, 13, 21]. Alternatively and aiming at the same purpose, a set of great principles of computing has been formulated recently [7, 8]. These principles contain »design« and »computing mechanics«. While the latter deals with the structure and operation of computations, design serves as an interface between computing and the society. Together these two principles integrate informatics within other fields of knowledge and practice which are necessary to obtain a consistent view of an increasingly complex world. This increasing complexity makes it clear that general education is not simply "teaching everything to everyone" any more. Today general education has to provide the people with the ability to make sense of "what surrounds us", to "structure the perception of the world" (see [1] for a more detailed discussion of structuring in the face of learning). And – for the sake of interchangeability – general education still should be acquired in schools.

This view of general education points at the necessity to combine facets of know-how and know-why in informatics teaching: Clearly enough the learners have to get acquainted with the use of modern technology. But at the same time they should obtain some knowledge of the technological and informational background of informatics in school. This not only means to teach the basic concepts of hard- and software, but calls for dealing with historical aspects in informatics classes as well. But has this call reached school yet?

One mark of a great educator is the ability
to lead students out to new places
where even the educator has never been.
[Thomas Groome]

The Status Quo – Historical Fragments in Informatics Education

Can we claim a certain awareness of the history of informatics when looking at classroom-situations? Or do we rather have to complain about the lack of historical aspects in informatics teaching? Looking at the situation in generally educating schools in Austria, we simply can't tell because the curriculum of the subject informatics gives an ample scope for the teachers. We neither know exactly what is taught in informatics lessons, nor do we know how far (or even if) the students are informed about history in the context of informatics. Furthermore, lacking any referring empirical research, we can only argue on an informal basis, obtained by

- searching the internet for documents dealing with the history of informatics,
- looking at literature about informatics didactics,
- surveying some text books used in informatics classes,
- examining current informatics curriculum.

A rewarding strategy to search the internet is using the search engine Google.[1] The results when looking for selected expressions at Google (December 2006) were extremely yielding: The search-phrases "history computer" (485.000.000 hits), "history computer science", (205.000.000 hits), "history computer science education" (96.700.000 hits) ranked highest. The search for similar German expressions also led to an impressive number of hits. In view of these figures one cannot complain about a lack of digital data covering the interdisciplinary area of informatics and history. This suggests that informatics teachers can build upon a sufficient data basis which is publicly available from anytime and anywhere. On the other hand, this availability doesn't guarantee that these chunks of information are selected and adapted for teaching.

One might expect that informatics didacts provide guidelines for teachers and students how to deal with material of that kind. But when examining books about informatics didactics the only trace of historical aspects can be found in [2, p. 50-79, p. 131-132], where the reader comes across a very comprehensive description of the history of informatics. Other authors confirm the quasi non-existence of historical perspectives in informatics education by neglecting the topic at all [13, 21]. Almost the same can be said about the textbooks that are used in informatics classes in Austria: Tables that provide a chronological overview of milestones in the development of the computer seem to be the state of the art when presenting the history of informatics.

Another source of information is the curriculum of the subject informatics. Since its introduction as a subject matter in Austria's generally educating schools some twenty years ago, informatics has remained to be a compulsory subject only in the 9th grade – the first grade in upper secondary level (see [16] for a portrayal of the development and the situation of the subject informatics in Austria's secondary generally educating schools). And it is there, where one paragraph of the related curriculum states, that "the students should gain insight into (…) the methods of informatics and its

[1] It is almost needless to say that the short history of the extremely successful company Google around its young, wealthy and still living founders Larry Page and Sergey Brin would give a nice introduction for an interesting lesson in informatics (who tells us that history in Informatics should only deal with developments which began at least ten years ago?). But sadly enough there is no evidence that this is sort of "common practice" in school!

typical mindsets, its historical development and its technical and theoretical fundamentals(…)" [15]. But this is only a hint for teachers to deal with historical issues looking beyond year-dates. Actually there is little evidence that teachers are really taking notice of it. Moreover, we assume that they do not even attach much importance to historical aspects of informatics. At this age, the curriculum and an established tradition of what to teach in informatics stress other issues like imparting skills in application software. Topics like this seem to dominate informatics lessons too much as to leave room for teaching history of informatics.

Looking at these results one gets a first clue but is obliged to look for further reasons: Why is the history of informatics not "en vogue" – at least in informatics lessons?

Education is not preparation for life; education is life itself.
[John Dewey]

Isn't Informatics too Young for Historical Evaluation?

Obviously, at the present there are only traces of history in informatics education. One might ask whether some didactical shortcomings within the subject informatics are the reason for this. Or is the lack of history-awareness rather an outcome of the structure of informatics itself?

At the beginning the "science of information" in the 20th century was positioned somewhere between mathematics and (communication) engineering. Mathematics served as a model and as intellectual source to obtain the status of a structural science devoted to basic research. Physics added a scientific foundation that unveiled information as the third "element" of nature, besides matter and energy. On the other hand it was the engineering approach that embodied the abstract concept of information in the shape of computing machines (see [12] for a more detailed discussion of the roots of informatics). These artefacts enabled society to get in touch with information. Therefore it is not surprising that the new field of research was labelled "computer science" (at least in the English speaking countries) and that the recording of events focussed on hardware or on outstanding pioneers at the most. But there was no history of informatics as a scientific field, no consistent portrayal of the genesis of the scientific principles.

By now this initial "structural gap" has been multiplied and deepened. While there is still a demand for the theoretical foundation of informatics, the pragmatic technology-orientation was (and still is) promoted by the expansion of application domains. The transition to "interactive computing" and the increase of the tool- and media-function of computers is dominating also the educational field. Thus the view of informatics shifted from "…the art of programming is the linking thread that gathers disparate branches into a single discipline." (E. W. Dijkstra 1989 quoted in [9]) to "Computer Science is the science of information, processes and their interactions with the world." [10]. The »single discipline« disintegrated into various branches and "the history of the different branches of informatics is suffering from rather heterogeneous research which allows only a vague outline of the various interdependencies." [12]

To make things worse, the traditional fundamentals of algorithms and formalisation are not sufficient to support the new applications. The algorithmic logical core has lost its guiding role as »Theory of Informatics« without any successor in sight, or, as P. Rechenberg states: "Informatics will not be able to reveal itself as true science until the Turing machine as THE model of theoretical informatics will be replaced by a better abstraction" [19].

This scattered structure of informatics hampers the writing of the history of informatics. With their means historians can neither decide the "correct" position in a scientific debate, nor can they provide a definition that is suitable for a certain discipline. But by taking a diachronic point of view they can show long-term trends, changing paradigms, persevering positions and they can point at the cultural and social context embracing scientific development. Therefore informatics isn't too young for historical evaluation, but at the moment it clearly is the wrong attitude to expect one single history of informatics as an outcome. We obviously have to accept different historical views into the field of computational mechanics.

The structural richness of informatics does not only cause historical diversity. It also makes it hard to define a consistent and enduring curriculum for a rather young subject. This might be the main reason why teaching of informatics in school traditionally focuses on topics that are commonly associated with computers, like application software, programming or databases. It is a pity that history of informatics is (almost) none of these topics.

We can't teach people anything,
we can only help them discover it within themselves.
[Galileo Galilei]

History Didactics and a Viable Informatical Approach

Judging from its label, "history of informatics" should not be an issue of the subject informatics alone. Focussing on historical processes and events in general, the subject matter history has its own point of view of technological (r)evolution. But in how far does this consider the dealing with the history of informatics as well?

Since years ago, the history of informatics never had been a topic in history teaching, simply because it was not part of the curriculum of history. In 2004 a new central curriculum had been designed and came into force. The subjects name was extended from "History and Social Studies" to "History, Social Studies and Civic Education". "Civic Education" should be a major part of history lessons for the seventeen and eighteen years old, including but not limited to "new media" and "multimedia" [14]. But what can be subsumed by "new media" in history lessons? One content that is suggested by the new Austrian schoolbook is the internet, the success story of Microsoft yet another [6]. While we are well aware that neither the history of the internet nor the history of Microsoft must be mistaken for the history of informatics, it should not be underestimated that this was the first reference to any kind of informatics within a history curriculum. Furthermore, the internet or Microsoft can be considered as starting points to deal with the history of informatics, looking at it "backwards" from present to past.

How to consider historical aspects of informatics in history lessons? One approach is to look at the history of informatics ignoring the "other" historical events. This can be done by focusing on outstanding representatives of informatics like Konrad Zuse, Alan Turing, Steve Jobs or Bill Gates to name a few. In doing so the historical analysis exhausts itself in disussing their lives, their work and their findings.
Another and a more rewarding way to introduce the history of informatics is called the "network approach". This means that the topic "informatics" has to be connected to other, coinciding

historical events. Examples for such an approach are the coherence of the "cold war" and the development of the internet or the linking of the entrepreneur-concept (as an aspect of mercantilism in the filed of economic history) with its analogy of informatics enterprisers. Needless to say that networked lessons are more challenging for both sides, the teacher and the learner, but this way of teaching history facilitates cross-linked thinking and the understanding of (social) structures, which are main didactical goals of history as a subject matter.
Moreover, there seems to be a third way to include relevant informatical aspects in history lessons, supporting the perception of chronological cross connections: Starting with contemporary events or phenomena, history teachers can point at parallels, similarities and differences between certain occurrences in history. Two examples might help to illustrate how informatics can come into play when choosing this approach:

- At the time of writing this article the dawning of internet censorship in China is of great concern to the internet community, being discussed in numerous newsgroups and reflected upon in several articles (see [18], [25]). Picking this topic, history teachers can not only point at political and social aspects of censorship in our time but also look at censorship as a raison d'état in former times. For instance, from the Austrian point of view stories about prince Metternich, who aggravated censorship at the time of the Napoleon wars, might be a good choice.
- The changes that were brought about by computers and communication technology at the end of the twentieth century quite commonly are designated as "digital revolution". In history lessons the students could be guided to study the reasons for and the consequences of different revolutionary events like the industrial revolution or political revolutions in the 18th (France) and 20th (Russia and Eastern Europe) century to identify common patterns and specific peculiarities. Then they should return to the digital one and see if it is a "real" revolution in the sense of the word

A motivational aspect adds to all of the three approaches sketched above: Due to the everyday use of informatics tools the history of informatics seems to be "closer" to the pupil's lives and thus the learners might be more interested in the evolution of informatics and its technology than in other topics of history. Furthermore, in the case of the internet the fascination by the technological possibilities can be utilized by letting the pupils look for additional information about historical events[2]. In doing so, history teaching enters the "domain" of information science: The information that has been found by the pupils has to be rated whether it is reliable or not. It is clear that in this constellation the didactical goal is not only to assist pupils in working on their own but to wage a transdisciplinary way of teaching as well. It is a nice detail that the latter is not restricted to the history of informatics alone but opens a much wider field of cooperation between the different subject matters.

Thus a multidisciplinary approach seems to be appropriate, too. A lot of examples can be given how informatics and history can work together:

- Just think of projects to create a homepage for certain historical topics, e.g. a school history, the history of a city or a famous person (maybe an informatics personality).
- Quizzes can be made about historical topics. There pupils can work together when conceiving the questions within history lessons and when implementing these questions during informatics lessons.

[2] The internet itself might be a good example for comparing different sources of information: While most authors claim it to be an outcome of the "closed world" of the cold war alone [24], there are others who state that "the Net is rooted in the open and decentralized world of the antiwar movement and the counterculture as well." [20].

- Another example is to work with multimedia utilities like DVDs or CDs. Producing digital videos in a historical context can add to the integration of history and informatics.
- Moreover, if picture editing is a topic of informatics, the design and production of posters with historical content might be a good idea. Starting as a source of information these artefacts can serve as a basis for discussions in history lessons, dealing with the hidden messages behind posters [17].

Supposedly there are much more ways in bringing history and informatics together. As a matter of fact not all of them can be realized in a few lessons, teachers have to choose. Multidisciplinarity can be an exciting and meaningful experience for all involved.

A great pleasure in life is doing what people say you cannot do.
[Walter Bagehot]

An Optimistic Look into the Future

Post-modern society is deeply involved in modern information and communication technology. Consequently it must be one goal of our education system to provide a framework of appropriate background knowledge for all members of future society. Such a sound basis must provide both, certain skills that enable the people to deal with technological tools and an informational groundwork that allows to judge technological development as well. Thus, entering the future needs awareness of the past.

Looking back at what we've found, in Austria it seems to be the subject history that is well prepared to deal with the history of informatics as a new thread interwoven within the history of the 20th century (and not only the 20th century!). Moreover, history is able to offer different approaches that allow for integration of this topic. On the other hand it should have come clear that something might get lost if an interdisciplinary historical issue like the history of informatics is given over to history and history alone.

Laszlo Böszörmenyi puts it this way: "Teaching informatics is teaching a way of thinking and understanding". Furthermore he points at historical aspects of informatics as "an essential part of such an educational process." [4] In other words: The "informatics way of thinking and understanding" can not only be found in circuits, algorithms or data structures but in the stories that form the history of informatics as well and it might hardly be unveiled looking at informatics history in history's way: It's up to the subject matter informatics to recognize its responsibility and to provide a balanced view of informatics by means of its history.

Of course, there are obstacles. The main issues of teaching and learning informatics are certain kinds of application software on one side and basic informatical concepts on the other – and these are the main issues for good reason as they provide the learners with the most necessary know-how and know-why to deal with informatics systems in their future life. Additionally, as in Austria's generally educating schools informatics is a compulsory subject for one year only it seems rather illusionary to add another (compulsory) field of interest.

Obviously, the strategy must be a different one. Looking at history, we can learn how to integrate the history informatics into informatics courses and preserve the traditional syllabus at the same time: Historical aspects can serve as a skeleton that interconnects different aspects of informatics,

both as technology and science. In doing so we can rely on a first comprehensive synopsis of possible and suitable content that is given by Marco Thomas ([22]). The spectrum covers almost all areas of informatics, beginning with the origin of binary numbers, algorithms, the mechanisation and automation of brain work, the thrilling history of cryptology and ending with the development of the internet. That's a start!

But there is still a lot to do. We, the informatics didacts have to provide good and more stories that help to illustrate informatical content from a historical point of view. We will have to point at cross-connections and to provide some ready to use material helping the teachers to integrate these stories into informatics classes. Furthermore – and that might be the hardest step – we must start arguing to build a culture of history-awareness among teachers (and among informatics didacts as well) to make sure that the provided material will be used at all. With this it seems helpful to seek the cooperation of history didacts to learn from each other and to build a framework for working together on the history of informatics. It might (no: it will) be due to these small (and maybe certain other, bigger) steps that informatics education will be augmented by a historical dimension.

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