Computer Literacy, IT, ICT or Informatics? What is going on in Austria's Compulsory Education in the Context of (Educational) Standards?

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Abstract. Compulsory education in Austrian schools is more than ever exposed to the pressure of imparting IT-skills and informatics-competencies to the pupils. The schools themselves are accountable for accomplishing this challenging task within their autonomy. The term informatics encompasses almost all activities in that field although in many cases IT (information technology) seems to be more suitable. This paper addresses the issue of an unclear and confusing terminology with respect to IT, ICT and informatics. This fact makes it even more difficult to provide a definition of desirable educational IT/informatics standards - as a response to ineffective curriculums. These standards are considered important to close the digital gap among the pupils in Austria after compulsory education.

1 Introduction

Without doubt the information and knowledge society exerts an enormous influence on education (in schools) in general and on secondary education in special. Among all subjects, informatics in Austrian schools is still discussed extensively. Policy makers are quite aware of the fact that every school has to provide the pupils with profound knowledge and skills with regard to IT and informatics.

The Austrian school system encompasses the elementary (grades 1 to 4), lower secondary (grades 5 to 8) and upper secondary level (grades 9 to 12/13). This paper mainly deals with the approaches of establishing informatics in secondary education in Austria with respect to the grades 5 to 9.

At the lower secondary level the Austrian school system is mainly structured into two types of schools, these are the secondary school "Hauptschule (HS)" and the secondary academic school "Gymnasium (AHS)". About 70% of the pupils attend the HS and about 30% attend the lower level of the AHS for four years. There is no comprehensive education in this age-group. Normally the cognitively more gifted pupils attend the AHS.

Beginning in the early nineties of the last century, the subject "informatics" has been implemented at the secondary lower level for pupils aged 10 to 14.years in various forms. At present there are only few lower secondary schools which offer the subject informatics continuously.

In the HS as well as in the AHS the penetration of informatics education was strongly dependent on engaged teachers and school administrators. At that time also the first attempts were made to integrate the application of computers in other subjects than informatics. In the retrospective this top down enactment, the success of the so called ITG ("Informationstechnische Grundbildung"), from responsible policy makers can be considered as wishful thinking. The integration of computers into other subjects has never really worked satisfactorily (see [9]).

Until now the lower secondary level in Austria must be seen as a patchwork with regard to an overall systematic supply of ICT/informatics knowledge and skills. This situation does not seem to get better in the upper secondary education where the digital gap between the students is getting even bigger. Considering the task of schools to provide pupils with adequate computer literacy in time, this situation is not acceptable.

2 IT/Informatics as a Part of General Education

It is obvious that information technology has dramatically changed the world outside our schools and is changing the teaching and learning environment within them. Nevertheless Rod Paige, U.S. Secretary of Education states, "Education is the only business still debating the usefulness of technology. Schools remain unchanged for the most part, despite numerous reforms and increased investments in computers and networks." (U.S.Department of Education, 2004, p. 22). The survey "Key data on ICT in schools in Europe" reveals that at the age of 15 a majority of European pupils claim to use computers in schools regularly. But the presence of computers at school does not guarantee that they are really used. Moreover, the PISA study [11] shows that the regularity of using the computer in school activities is still very heterogeneous across all investigated countries. While in some countries about two-thirds of the 15-year-old pupils use computers at schools once or several times a month, there are enormous differences between countries, the schools within a certain country and even between classes or groups within schools. This applies to the lower secondary education in Austria. In fact, in about 20-30% of the HS informatics is a separate subject. In the AHS the situation is similar.

However, at the last stage of compulsory education, that is exactly the PISA-age of about 15 years, the Austrian school system provides for all pupils systematic

IT/informatics instruction/education in the form of at least two hours per week. At this point it can be argued that this is definitely too late.

Baumert enumerates in [1] five basic cultural tools respectively basic cultural techniques. These include mastery of the common language, mathematical modeling, the competence in at least one foreign language, self regulation of acquisition of knowledge and last but not least IT-competence. We have to take leave from the imagination that a contemporary canon of education can ignore basic knowledge and skills regarding the ubiquitous and powerful IT-systems surrounding us. ICT and Informatics can therefore be considered indispensable in every educational process. Many countries today consider understanding ICT and mastering basic skills and concepts of ICT as part of the core of education, alongside reading, writing and numeracy (see [10]).

ICT is one side of the coin, informatics the other. "Does ICT eat or feed informatics" was the topic of a noteworthy panel discussion held at the ISSEP conference in March 2005 in Klagenfurt (http://issep.uni-klu.ac.at), which, expectedly, did not lead to any clear conclusion.

Since 1985 when the subject informatics has been implemented in all Austrian secondary academic schools in grade 9, this term is frequently in use and quasi a placeholder for everything which has to do with computers in schools. The artificial term "informatics", deduced from "information" and "automation/automatics" has its origin in Europe and (till now) is not in frequent use in other parts of the world.

There is a general consensus among the public and educators that pupils and students need to be "computer literate." However, Eisenberg and Johnson (see [5]) pose the following questions on the meaning of computer literacy: "Can a student who operates a computer well enough to play a game, send email or surf the Web be considered computer literate? Will a student who uses computers in school only for running tutorials or an integrated learning system have the skills necessary to survive in our society? Will the ability to do basic word processing be sufficient for students entering the workplace or post-secondary education?" Their answer was, "clearly not.".

Even if students can also "survive in our society" (not only in some schools or universities) without computer skills - which should be still possible! -, the most important question remains: Which accountability do national educational systems have to assure that all pupils are well prepared for succeeding in our digital society at the end of their compulsory education.

This issue has not been addressed by the responsible Austrian policy makers sufficiently. Twenty years ago Austria's ministry of education implemented the compulsory subject "informatics" for 15-year-old pupils in the AHS. This has been considered in 1985 as a very progressive action. In the last 20 years a drastic shift took place, as regards the rapid development of hardware, software and the pressure on schools to impart ICT/Informatics knowledge and skills much earlier than at the age of 15.

From 1990 on there were more or less ineffective top down enactments to implement informatics at the lower secondary level. The result is that today we face an undesirable variety of IT- competencies among the pupils at the end of their lower

secondary education. The very successful bottom-up measures taken by some HS and AHS in the form of autonomous decisions must not conceal the fact that an unacceptable number of pupils still completely lack in basic IT competencies [3].

The survey in [7] shows the trend for an integrated approach using ICT. In some countries, ICT is part of the compulsory minimum curriculum of pupils. Official recommendations regarding these approaches are fairly similar among the countries. Among the official aims of the curriculum, activities involving the use of software, information searches and communications networks for extending knowledge of various subjects are uniformly the most representative, irrespective of the level concerned in compulsory education. In many countries, the amount of time set aside for ICT is very flexible. Only in a few countries and particularly in those of central and eastern Europe, there is a minimum annual number of hours to be marked for teaching ICT as a subject in its own right. Whereas ICT is the common term in most European countries, this is not the case for Austrian schools, where it is called "informatics".

It is not surprising that we can find a similar situation in Germany. ICT and informatics are implemented throughout the sixteen autonomous federal states very diversely. The situation there is even more complex and inhomogeneous than in Austria. Although many efforts have been made to establish informatics at lower secondary level (Sekundarstufe I), only very few federal states succeeded.

Contrary to most international approaches, the German requirements of implementing IT/Informatics are much more demanding, aiming at conceptual knowledge and deeper understanding of informatics systems, and going far beyond superficial instruction in computer applications. Even with the support of more than ten professorships spread over Germany in the area of didactics of informatics [7] and regular conventions and recommendations from the influential German GI "Gesellschaft für Informatik", convincing policy makers of the importance of informatics as a mandatory subject in the lower secondary level proves very difficult. Unlike Austria, in Germany there is very little school autonomy. This means that the average IT-education in "Sekundarstufe I" can be considered as comparatively poor.

3 Global frameworks, definitions and approaches

The importance of IT/informatics education is not only restricted to Austria, Germany and the rest of Europe. Global initiatives to establish frameworks for IT/Informatics curricula for all stages prove to be a worldwide concern and can be identified in form of proposals from very prominent institutions such as UNESCO/ IFIP, ISTE and the ACM.

Ludger Humbert [7] stresses the importance of reinforced international networking in the field of informatics in schools and at the same time complains that the acquisition of IT skills is primary and dominating too much, at dispense of a deeper reflection and concepts of informatics.

If we look at the contemporary curriculum scheme for secondary schools [14], the following four areas can scaffold and categorize what has to be done for students to improve their knowledge and skills in ICT.

- ICT Literacy (where ICT skills are taught and learned as a separate subject)
- Application of ICT in subject areas (where ICT skills are developed within separate subjects).
- Infusing ICT across the curriculum (where ICT is integrated or embedded across all subjects of the curriculum).
- ICT specialization (where ICT is taught and learned as an applied subject or to prepare for a profession).

It is remarkable, but not surprising that the task force around T.van.Weert [14] - in charge of this ontology - decided to use the uniform denotation "ICT". Here ICT is used, applied and integrated in all activities of working and learning on the basis of conceptual understanding and methods of informatics. This is a remarkable confession about having troubles with terminology. Can the definition of "ICT by methods of informatics" in this framework [14] hold as a sustainable basis for a further framework?

Every definition has its limits and is vulnerable as the one above. The question arises whether this proposed framework can be applied to the lower and upper secondary level of general education. As Austria's curricula and the contemporary reality in schools are concerned, there is fairly much accordance with the framework above. You just have to replace "ICT" with "informatics".

In order to enrich the discussion about terminology regarding the buzzword "e-literacy", the following three terms can be found:

"Computer literacy" can be considered to include the minimum knowledge, know how, familiarity, capabilities, abilities about computers which are essential for a person to function well in the contemporary world [2].

"Informatics literacy" is the ability of a person to recognize the role of informatics and informatics systems in the world, to evaluate (phenomena) well-found on the ground of informatics know how and to deal with informatics and its applications in a way which meets the challenges of the contemporary and future life of that person as a constructive, engaged and reflecting citizen [7].

"ICT literacy" is the interest, attitude, and ability of individuals to appropriately use digital technology and communication tools to access, manage, integrate, and evaluate information, construct new knowledge, and communicate with others in order to participate effectively in society [8].

Without looking for sources of further definitions in the context of e-literacy, ICT and informatics, we can state an increasing affluence, which makes the situation about implementing ICT and/or informatics in schools not any easier.

"Reinventing the wheel" means that a generally accepted technique or solution is ignored in favor of a locally invented solution. This definition can be widely applied to various definitions in the context of IT/informatics, computer science etc.

"Variatio delectat" is a well known Latin proverb and can be translated into "Diversity delights". What can be successfully applied for one's way of living in

order to escape boredom might be rather confusing and frustrating in the context of science or of a subject at school. Although many teachers react very pragmatically to the unclear terminology in that they simply ignore it, from a scientific and didactic point of view this state cannot be considered satisfactory. Many teachers are too much concerned about operative teaching and do not care about reflecting about terminology too much. In Austria's lower secondary general education, the discussion about teaching IT, ICT or even Informatics for providing e-literacy or computer literacy does not really matter. There are few experienced teachers who are beginning to reflect about mere product training such as in the form of the preparation of pupils for the ECDL. Just teaching for the test is not really brilliant and does not result in informatics literacy.

A UNESCO/IFIP paper [14] defines "informatics as the science dealing with the design, realization, evaluation, use, and maintenance of information processing systems, including hardware, software, organizational and human aspects, and the industrial, commercial, governmental and political implications of these".

IT (Information Technology) is defined as "applying (artifacts of) informatics in society". ICT (Information and communication technology) is considered "the combination of informatics technology with other, related technologies, specifically communication technology."

These definitions are very compact, but not very useful in an educational context.

Table 1. A Comparison reflecting the difference between IT and informatics

IT	Informatics
specific education	general education
concrete, practical	abstract, theoretical
application oriented	fundamental, basal
instruction, training	education
technical schooling, courses	class, lessons
certificates	school reports
product knowledge	conceptual knowledge
just in time and short term learning	sustainability
instantly available knowledge	general knowledge
using software	modeling and developing software
applying software	reflecting the use of informatics systems
competencies, skills	knowledge, comprehension
executing tasks	problem solving

The borders can not be drawn exactly. They are fairly indistinct and floating. But the table above should provide more clarification and moves informatics definitively towards general education with a certain degree of product independency and conceptual knowledge.

This dichotomy, with the (job) training on the left side and the (academic) "ivory tower" on the right side, still leaves one major concern. It may even exacerbate the diversity problem. The distinction between "pure" informatics (or computer science?) and applied informatics (IT, ICT) also troubles secondary education. We know that pupils are initially attracted to informatics through computing in context

and also product using (as opposed to games or computing for its own sake). Once they have achieved a certain level of special IT-competencies, they come to believe to be already computer scientists. This is why some of them are left pretty surprised when they enter university and begin to study informatics.

Doubtlessly, the dichotomy of IT and informatics causes some confusion for insiders. While other science, technology, engineering and math disciplines have improved their diversity in the last years, ours has gotten significantly worse.

What prevents us from looking at related subjects such as mathematics as a model? From primary to higher secondary education we find just one single subject called mathematics. Mathematics encompasses the wide spectrum from simple counting in elementary schools (is this really mathematics?) up to calculus and further concepts.

The big question is: Shall we adopt this model of an "umbrella subject" or shall we clearly differentiate between IT and informatics with regard to the two different subjects at school?

In the view of the (Austrian) public, informatics is a placeholder for almost every activity in the context of computers and their applications. This begins with handling software, preparing pupils for external certificates as well as for modeling, programming and developing software and solving problems with informatics methods, as well. Obviously, a vast majority of pupils, teachers and policy makers involved can still live with that. Only a little group of informatics teachers and didacts begin to discuss this (theoretical) dichotomy between IT and informatics and its impact on informatics education.

4 About Curricula, the ECDL and Educational Standards

Another problem arises when we look at (global) curriculum frameworks with respect to their efficacy in inducing teaching and learning processes and above all the measured learning outcomes. Marsh and Willis (see [11]) define a curriculum as an "interrelated set of plans and experiences that a student undertakes under the guidance of the school." Moreover, they distinguish four types of curricula: the planned, the enacted, the experienced and the hidden curriculum. Nobody would question the importance of enacted (written) curricula as tools for normalizing and controlling the educational tasks of schools.

In Austria (and Germany), a remarkable debate on curricula is going on. Obviously, curricula do not have the expected impact on the outcomes of the pupils. The emerging buzzword in this context is "educational standards". Obviously, these standards aim at the crucial part of the curriculum, namely the definition of its objectives which are often expressed in terms of learning outcomes.

The recent PISA-study 2003 [12] revealed some painful deficits of Austrian pupils in the area of math and problem solving, so that the ministry of education immediately reacted to that situation in supporting the shift from input orientation to output measurement.

Whereas educational standards are now being developed for the subjects German, English and Math, already since 1998 a remarkable development in the

Austrian educational system with regard to IT education has taken place. Under the patronage of the ministry of education, the European Computer Driving License [ECDL, see http://www.edu.ecdl.at] exerts a veritable influence on the Austrian school system. The ECDL certificate is offered at all stages of secondary education and some schools even adapt the ECDL core syllabus as the basis of the subject "informatics". This is unique in Europe. The syllabus of the ECDL consists of seven modules and matches exactly with the proposed framework in [14] except for the modules "Ethical Issues 2" and "Jobs and/with ICT".

When speaking of basic IT-skills, one cannot ignore the ECDL. The ECDL with its global extension ICDL (International Computer Driving License) is available in about 140 countries worldwide and has been translated into 36 languages so far. At the moment it is the world's leading and largest vendor-neutral end-user computer skills certification program. With presently almost 6 million participants, it is internationally recognized as the global benchmark in this area.

In Austria, many lower secondary level schools set their own informatics curricula. As a matter of fact these curricula resemble the syllabus of the ECDL to a high degree. This is not surprising. Unfortunately, we still lack in exact figures, but recent statistics show that till now about 250.000 modules have been passed in lower secondary education. If we compare that number to about 400.000 pupils in this age-group and the fact that the ECDL consists of seven modules this number is remarkable but not impressing. At the moment less than 10% have passed all modules.

Although the Austrian model of ECDL in schools can doubtlessly be considered successful, there are some concerns:

- The ECDL certificate is not free of charge, it costs 120 €.
- It is originally designed for adults and aims at vocational training.
- Many informatics teachers express their concern about the commercial aspects and do not support its infusion into schools.
- From the point of view of critical informatics teachers, it is too much of product training and does not meet the needs of a deeper (informatics) education.

These are some reasons why the ECDL in Austrian secondary schools, although all in all a popular certificate, is limited to a certain clientele among the pupils. Presumably it will remain voluntary.

5 The Future of Educational Standards

Independently of the further development of the existing de facto standard ECDL/ICDL, there are several groups in Austria (and Germany) developing IT/informatics standards for secondary education. These initiatives aim at more comprehensive educational standards also including deeper understanding and problem solving aspects. Whereas the ECDL is already widely accepted as setting benchmarks with respect to basic IT skills, the work in progress (see [4] and [15]) in some committed Austrian and German task forces is no more than in a rudimentary state up to the present. Even if these ambitious educational standards for informatics

should be established, a long road of acceptance is impending. It has then to pass the practical test to being accepted among (critical) informatics teachers and pupils.

Standards, in general, are very important in terms of constituting a common fundament for optimizing the use of artifacts or regulating the living together of people. Everybody dealing with hard- and software appreciates this. In the context of educational processes, standards are quite new. Concerning the alarmingly fast growing digital gap among pupils of the same age, educational standards in IT/informatics should also be developed quickly and then widely used to improve the quality of preparing our pupils for the future.

The prospects of realization of these educational standards seem to be good. ICT feasibility in the context of the PISA study conducted in 2003 was considered a success [6] and moreover the development of ICT literacy as a new assessment domain of PISA has been considered relevant. We may expect that policy makers of the PISA-participating countries will react to that in making financial resources available in order to support the development of standards which will hopefully raise the average IT-literacy at the pupils' PISA age.

The development of widely accepted and output oriented educational standards could help bridging the obvious gap between IT and informatics and may address the demands from policy makers and the informatics community as well. As a consequence within their autonomy Austrian schools would have to take appropriate measures in form of establishing an increasing number of informatics classes and/or provide a better integration of informatics education in other subjects. At present eLearning acitivities [16] especially in the AHS noticeably emerge and increase the need for IT competencies on the ground of a profound informatics education.

6 Conclusion

We still realize an annoyingly diffuse use of terminology such as "computer literacy", "IT", "ICT", "computer science" or the common (middle and eastern European term) "informatics", which at least in Austria has to hold for almost every activity with computers. Standardizing the terminology would therefore be a worthwhile global task.

Lower secondary education can still be regarded an important stage with respect to IT/informatics education. Due to the fact that not all pupils in Austrian schools experience the first systematical instruction in IT/informatics, the digital gap is still undesirably wide at this level.

Standardizing the learning objectives in the form of educational standards as extended curricula with the focus on output measurement could improve this situation. The external certificate ECDL/ICDL, which is offered and accepted in at the lower secondary schools in Austria, is not compulsory and due to autonomy it does not reach the majority of pupils.

Educational standards for informatics in addition to the quasi-standard ECDL/ICDL are presently developed by formal and informal working groups. In the view of many informatics teachers this is regarded as a necessary process. The result in form of obligatory learning objectives and appropriate assignments should

guarantee that a vast majority of pupils aged 15 will not only dispose of basic IT skills and ephemeral software handling. A deeper understanding of informatics, accompanied by more creativity, problem solving and reflection would be very much appreciated also at the lower secondary level.

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