Informatics and Standards at an Early Stage

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Abstract: Since the beginning of the school year 2002/2003 almost all comprehensive secondary schools in Carinthia/Austria have offered the subject Informatics in the first two grades to an extent of an hour per week. The preliminary results of this project will be discussed in this paper, including the outcome of an online survey which dealt with various organisational structures and the teachers' attitudes towards Informatics in the first two school years. The results of another online survey will be shown in an overview regarding the basic conditions at schools and the informatic pre-knowledge of all the pupils involved. The main objective of this project is to define a minimal standard by means of a democratic process of all schools involved.

1 General informations about the project

In most federal states of Austria there is no subject Informatics in comprehensive secondary schools in the first two years. Informatics, if at all, is taught in an integrative manner in other subjects. The Austrian ministry of education leaves it to the schools to install Informatics at the expense of other subjects. Actually this does not happen very often. Due to a nationwide reduction of two lessons a week one year ago, many initiatives to introduce Informatics as a new subject have been cancelled as well. As a consequence it is even harder to introduce Informatics now.

Since the beginning of the school year 2002/2003 almost all comprehensive secondary schools in Carinthia/Austria have offered the subject Informatics in the first two grades to an extent of an hour per week. About 15 schools, 85 teachers and 2000 pupils between 10 and 12 years are involved in the project which is financed by an initiative launched by the Carinthian local school administration. Additional hours had to be remunerated to allow the splitting of the first and the second classes into smaller groups. These groups are taught in special Informatics classes to an extent of an hour per week.

After one year another project organized by the pedagogical institute (PI) in Carinthia was started to evaluate Informatics at the first two grades of secondary school. The main objectives were to reinforce networking initiatives between the schools and teachers involved and to install a standardized curriculum. For this purpose meetings of the school coordinators were arranged and a web based document management system was installed to support the contact between the school coordinators and the exchange of experience.

A specific result of this network and evaluation was the definition of a standard that most of the pupils should achieve after two years of Informatics. The curriculum which was developed consists of operationalized teaching objectives and should cover about 2/3 of the teaching time available. Moreover a pool of exercises and relevant informatic problems appropriate for this age-group were collected from the schools and should support both teachers and pupils in achieving the standard.

This paper shows some results of this project including the outcome of empirical research which was carried out at the beginning of the project. One survey dealt with the various organisational structures of the Informatics classes. Furthermore general information about the subject matters was collected and the teachers' attitudes were investigated. Results of another online survey will be shown in an overview of the infrastructure at schools and the pupils' previous knowledge of Informatics.

Furthermore this study should point out that especially at the transition of primary to secondary schools an attempt for standardization is beneficial to avoid a further digital divide among the pupils at an early age.

2 General statistics and empirical data collected by the project coordinators at the schools

This chapter provides important information on statistical facts regarding the preconditions at the participating schools. Thirteen project coordinators held meetings at their schools and collected data which was finally put into an online database.

13 of 15 possible comprehensive secondary schools, called "Gymnasium", in Carinthia are taking part in this project. In eleven schools the subject Informatics is compulsory, in two it is offered on a voluntary basis as an addition to all other subjects. If Informatics is compulsory for an hour a week (or for two hours a week in a secondary school) – it has the same status in the canon as all the other subjects taught in the first and second forms of the Gymnasium. This inclusion in the canon resulted in the reduction of the following subjects by an hour. German (4), Handicrafts (4), Biology (3), Physics, Geography, History, Music, Sports in each case (1).[1] These reductions were agreed by the particular school forums consisting of representatives of pupils, teachers, and parents.

[1] The numbers in brackets indicate the number of schools.

Almost 60 groups in the first forms, just as much groups in the second forms (altogether about 2000 pupils) are involved in this project. On an average these groups consist of 16 pupils. In more than 50% of the schools more than 16 students are in a group due to the relatively high number of pupils in the classes of the first two forms of the schools.

75% of the Informatics classes are regularly held in the morning.

About half of the schools organise their Informatic lessons periodically. Thus Informatics is taught to an extent of two hours in succession every fortnight.

The denotation of the subject is not standardized. In about half of the cases it is called "Informatics", followed by "Introduction to Informatics", "Information technology" and "Basic education in Informatics".

85% of the Informatics lessons take place in the computer lab. Only a quarter of the pupils have to share the PC with a colleague.

Teachers' remarks on Informatics classes

85 teachers with different education (or training) and training courses in Informatics are involved. About half of them completed extended courses in Informatics and acquired certifications such as the (Advanced) ECDL. More then 70% have long-term experience in teaching Informatics in upper grades.

Their motivation is to a great extent a strong personal interest in helping young people master the fourth cultural technique and to awake and reinforce their interest in this field.

At this point it should be mentioned that in some schools the newly generated subject Informatics had to be covered by teachers who are not necessarily interested in teaching a subject they are not trained in and which they are not in favour of.

The following numbers show the teachers' satisfaction with their teaching of Informatics:

- very satisfied 42 %
- satisfied 34 %
- not satisfied 8 %
- no comment 16 %

This corresponds to a great extent to the way school administrations assigned the lessons in Informatics to the teachers. In more than 70% of the cases these assignments are based on agreements, personal wishes and the qualifications of the teachers. The rest of the lessons is allocated rather involuntarily and concerns teachers who did not have a formal training in Informatics.

Apart from relatively large groups, a very lively atmosphere during the lessons together with the practical work on PCs sometimes makes teaching very strenuous and by far more demanding than in other subjects. Due to relative inhomogeneous groups preparations for Informatics lessons are extraordinarily intensive. On the other hand the pupils' high motivation and interest can make up for time consuming preparations. Teachers also appreciate the fact that Informatics allows integrating new ideas spontaneously into their lessons. For an inventive teacher the subject Informatics offers a wide range of opportunities.

Forms of organization

Especially at the beginning an hour of Informatics a week cannot be considered sufficient to cover all the difficulties in establishing the same technical working conditions for all students. Problems such as logging in and out together with a range of other technical problems might reduce the productive time of an hour enormously.

Therefore "two hour-lessons" every fortnight are favoured by several teachers. However, this approach also bares the risk of more lessons being cancelled because of holidays, teachers' training or illness. The period between Informatics lessons might also be too long.

Another criticism to this approach is the students' resistance to practise typewriting at home.

It is not surprising that in all schools most of the lessons consist of a mix of instructional and constructive phases. About 2/3 of the schools involved support project oriented and group work. Individual work (with worksheets or online practising), cross-subject projects and self study on the basis of E-Learning material contribute to the wide range of didactic approaches in Informatics classes. The students are assessed by active participation, tests, homework and (sometimes) final tests.

Number of computer labs at the schools involved

- two in 3 schools
- three in 4 schools
- four in 3 schools
- five in 2 schools

Ratio of PCs per total number of pupils

- less than 1:30 in 2 schools
- between 1:25 and 1:14 in 2 schools
- between 1:12 and 1:9 in 4 schools
- between 1:8 and 1:6 in 5 schools

Ratio of freely accessible PCs in relation to the total number of pupils

- less than 1:100 in 5 schools
- between 1:100 and 1:50 in 6 schools
- between 1:50 and 1:30 in 1 school
- between 1:30 and 1:25 in 1 school

The schools are providing

- a personal login 100%
- personal webspace 67%
- a personal email address 77%

In a third of all schools a special preparation for the ECDL (European Computer Driving License) is offered and in almost 40% of the schools these two initial years are followed by further lessons in Informatics in the next two years.

Software and tutoring software besides MS-Office

Paint Shop Pro, Corel Draw, Paint, typewriting programs, Dreamweaver, Photoshop, Goldfinger, German-, English- and Italian- tutoring software, Bit Media ECDL, Encarta, Interaktiv durch Österreich, Capella, Tippmaster, ECDL-CD, Slovenian tutoring software, etc.

What is being taught in Informatics lessons?

An internal curriculum is predominant at schools (> 90%). Only one school makes use of a school book, in all the other schools teachers work with material they prepared themselves. The Internet very often serves as an excellent source for suggestions and useful material. Additionally E-Learning material, exchange of documents/material between colleagues, computer magazines and books on Informatics are widely used.

Topics covered in the period September 2002 until December 2003

• Input (keyboard/mouse)	16%	(min: 2%, max:	47%)
• hardware	4%	(min: 2%, max:	6%)
• operating system(s)	5%	(min: 2%, max:	11%)
• file management	8%	(min: 3%, max:	14%)
• word processing	19%	(min: 13%, max:	30%)
• spreadsheet	11%	(min: 0%, max:	25%)
• presentation	12%	(min: 3%, max:	18%)
• graphics/picture editing	5%	(min: 0%, max:	8%)
• communication	10%	(min: 3%, max:	25%)
• other topics	10%	(min: 0%, max:	13%)

This table discloses very well the different views on the importance of the various topics. Above all the handling of the keyboard is regarded as being extremely important and therefore is trained to a great extent of the time. Obviously there are comparatively big differences at the schools regarding the weight of the various topics.

3. Results of an online survey among the pupils

From January to February 2004 an online survey was carried out among pupils participating in this project. The questionnaire consisted of about 20 items. Three of those, which will be discussed shortly, caused a lot of interesting reactions:

- Did pupils have previous knowledge about computers after primary schools?
- What are the (hardware) preconditions at home and how intensive is the pupils' computer use at home?
- What are the pupils' attitudes towards the subject Informatics so far?

Fortunately the pupils' feedback was extremely high with 1800 of about 2000 taking part in the survey and therefore the result can be regarded as very reliable. The most interesting results of this survey are presented in the following charts and are grouped by the schools involved thus making meaningful comparisons possible.

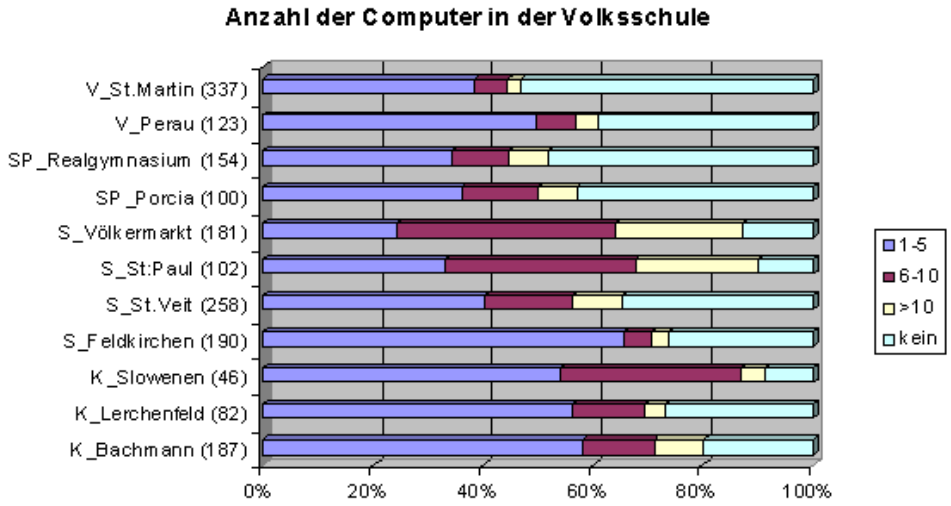

Chart 1: Number of computers in primary schools

This chart clearly shows that the average number of computers in primary schools in Carinthia varies in the particular school districts. Since most schools are still short of PCs the assumption that pupils are systematically introduced to Informatics is not tenable.

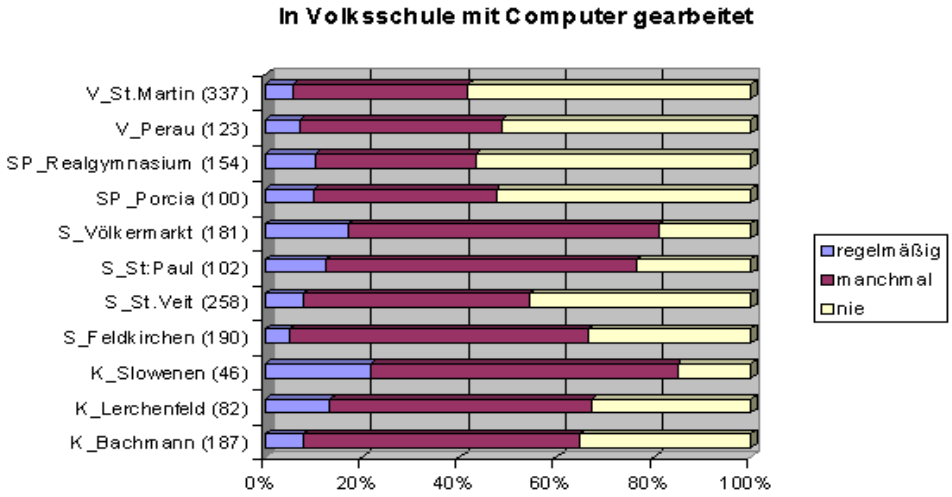

Chart 2: Working with computers in primary schools

This chart supports the thesis that very few pupils regularly worked with computers at primary school (about 10%). However, about 40% of pupils did have experience with computers at primary schools.

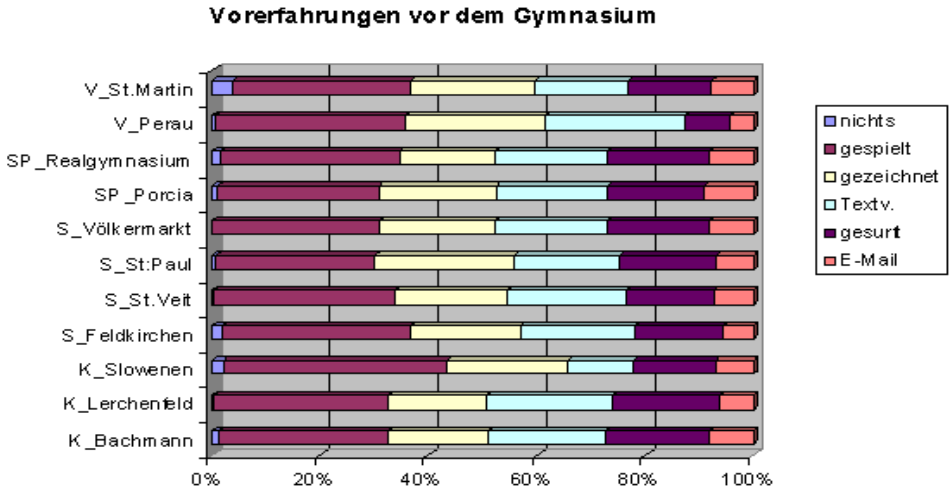

Chart 3: Experience with computers before attending the Gymnasium

Nevertheless, outside school 80% of the pupils gained experience with computers by playing games (30%), word processing (20%), using the Internet (20%) and e-mailing (10%).

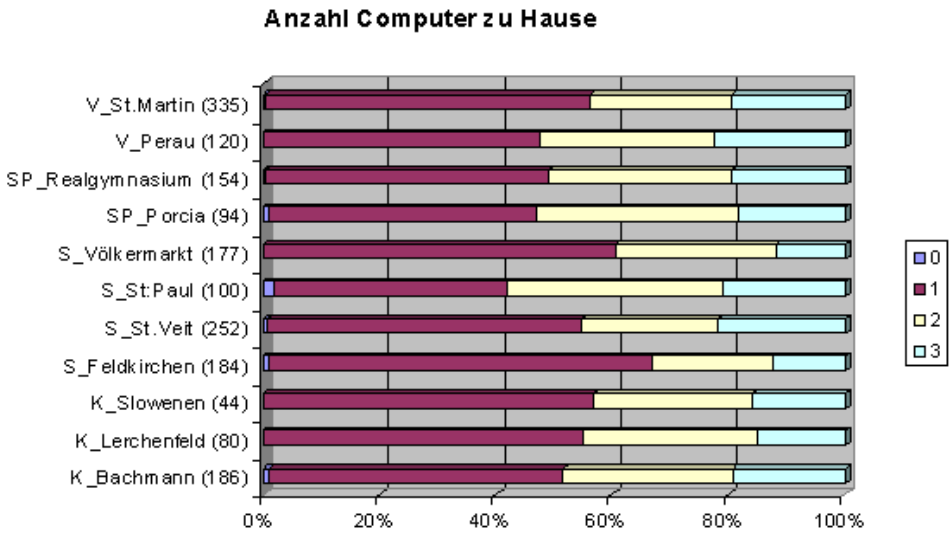

Chart 4: Number of computers at home

This chart impressively shows the saturation with computers at pupils' homes. The percentage of pupils with no access to computers at home has reached less than 1%!

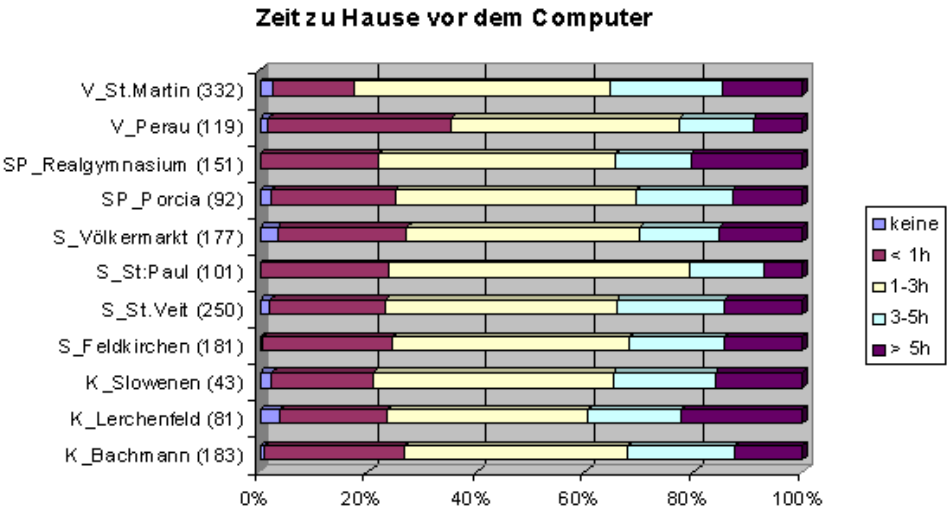

Chart 5: Time spent with the computer at home

How much time do pupils spend in front of the computer in general? This graphic shows that the average time pupils use computers at home lies between 1 and 3 hours a week.

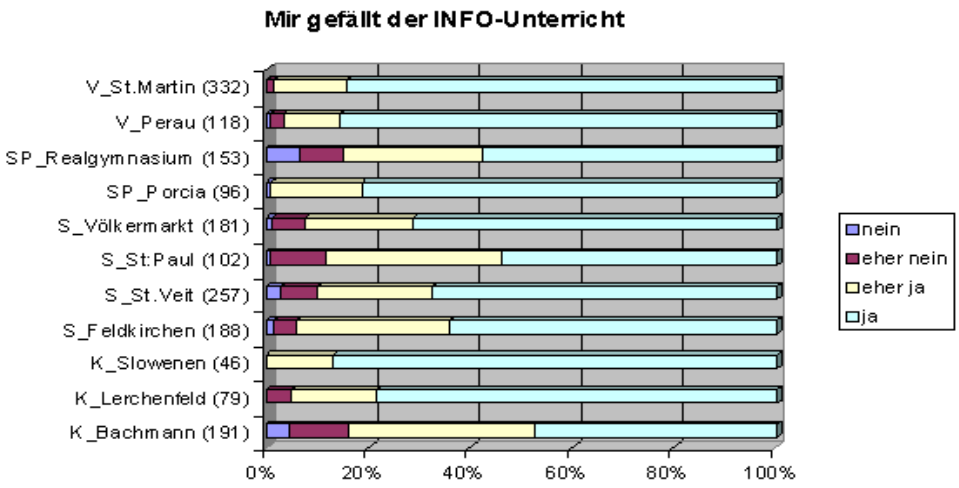

Chart 6: I like Informatics

This reveals the fact that the pupils like the subject Informatics above-average.

A further analysis shows that there is a difference in this attitude between boys and girls. In general boys like informatics a bit more than girls.

There is also a difference between the first and the second form. In the second form, after one year of Informatics, the enthusiasm (of boys and girls as well) for this subject decreases significantly.

4. Finding the standards

The third and major step of this project was to establish a standard curriculum. As mentioned above present teaching of Informatics differs from school to school to a large extent. Since this situation is not tenable the call for standardization can no longer be ignored.

In order to get rid of this situation of diverging teaching objectives all schools involved in this project presented their specific curricula by putting all the detailed learning items into a structured online database. Afterwards the project team categorized and clustered these items. Finally, in a teamwork process the curriculum took concrete form.

The main teaching objectives of this minimal standard are as follows:

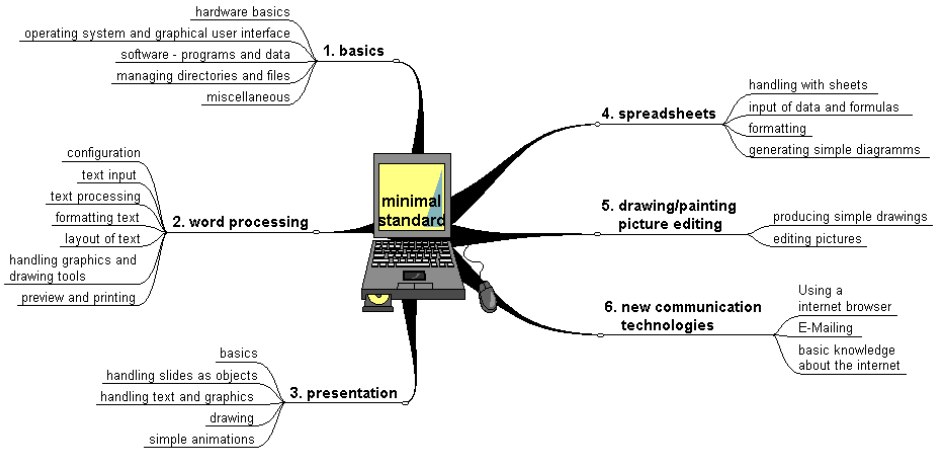

Figure 1: The categories of the minimal standard

Figure 1 shows the main items of the minimal standard. There is of course a further classification where the teaching objectives are operationalized which means that they can be assessed and tested.

This definition of a standard for 12-year-old pupils is not really revolutionary. Nobody would expect this. But it is a compromise of many teachers who are involved in this project. The decision about this curriculum was unanimous at the end and it was preceded by constructive discussions. Nevertheless especially two aspects are worth mentioning. First there was a slight uncertainty whether "typewriting" should become part of the standard or not. At last the coordinators came to the conclusion to abandon its integration into the definition of the standard. Of course typing skills are important, but they should be acquired in training courses outside Informatics classes. However, the knowledge of some main keys on the keyboard should be part of the standard.

The issue of spreadsheets led to a discussion as well. In the end all participants were convinced that the basic handling of spreadsheets is essential and indispensable especially with regard to applications of other subjects such as maths and geography.

On the website http://www.schulinformatik.at you can have a look at the curriculum and the syllabus respectively

5. About curricula, syllabi and standards.

This syllabus can be understood as an orientation guide for both teachers and pupils Nowadays teachers are very often confronted with diffuse curricula which leave them alone with the decision what to teach. Experienced teachers might not have problems with such a curriculum, but in most cases, especially when teaching a dynamic subject such as Informatics, standards with operationalized learning and teaching objectives are often regarded as a desirable orientation guide.

Apparently many Austrian teachers were very happy when the idea of the ECDL (European Computer Driving License) emerged and the first syllabi of this international certificate became generally known. For the first time they had something concrete at their disposal and could teach the pupils according to an internationally accepted curriculum.

The theoretical background of a detailed definition of standards can be deduced from a didactics which is orientated on operationalized teaching objectives and can be found in an article of Christine Möller [Gu02]. This didactical approach assumes that

- the finding of the teaching objectives should be a task for people in charge of the curriculum,
- the emphasis should lie in a clear description of these targets, that means in a precision which can only be achieved if the performance of the learner as well as the content by means of which the performance (knowledge, skills, competence) can be assessed is determined distinctly,
- precise or operationalized targets are a necessary (but not always sufficient) precondition for an adequate choice of teaching methods,
- the success of the learning and teaching process can only be verified by means of the teaching objectives

This didactical approach is prescriptive in a sense that it should provide both teachers and learners with concrete methods for planning, organising and assessing their lessons.

The planning of lessons which orientates towards teaching objectives can be identified by a determinable behaviour of the learners on the basis of concrete guidelines. There should also be a precise classification of the goals into specific categories. This process of operationalizing is completed only if detailed teaching objectives are embedded in a set of fundamental ideas and some superior objectives [cf. Eigenmann/Strittmacher 1971].

When the planning phase is finished teachers have to find the appropriate methods to support the pupils in reaching the teaching objectives. This is not an easy task but it is easier to plan when the objectives are clear and well defined.

The choice of appropriate methods is up to the teacher and nobody can relieve him from this duty.

The last but very important part in this didactic approach is assessments. Assessments should prove whether the learning process was successful or not. The task of constructing adequate and valid tasks and problems according to the curricular goals is very demanding and time consuming. But it is necessary in order to evaluate the result of every learning process.

The advantages of the didactic approach described are obvious:

- Transparency
  Concrete teaching objectives provide an informative basis for pedagogical argumentation and are results of an appropriate choice of the subject-matter. They make understandable the objectives of a curriculum.

- Assessing
  Teaching objectives provide for clarity (for all the people involved in the learning process) and can be a basis for a fair assessment system. At this point it should also be mentioned that focussing exclusively on operationalizing holds the danger of an uncontrolled mechanization of education.

- Efficiency
  Assuming concrete teaching objectives are the basis of an adequate learning organisation it can be deduced that the learning situation is clear and unambiguous which means that there is a chance of positive reinforcement for teachers and learners.

Therefore this didactic approach is a very efficient instrument of constructing a desirable behaviour in a sense that the students know what is expected from them and that they have the chance to achieve these objectives.

These theses lead to the issue of "standards" which is currently being discussed intensively not only in Austrian schools. Standard (in the context of school and education) is just another word for focussing on the desired learning results of the pupils [Do04]. From the seven criteria for educational standards [Kl03] three should be pointed out here:

- Cumulativity
  Educational standards refer to competences which have been acquired by a learner so far. Therefore they aim at cumulative, systematically networked learning.

- Commitment for all
  The minimal standards should be universally valid and can be expected to be achieved by (almost) all pupils at a certain age in all types of schools.

- Realizability
  The learning objectives should be achievable with realistic effort.

At the moment in Austria a nationwide definition of standard items is in progress, but until now restricted to the subjects German, Mathematics and English. The ministry for education plans introduce the handling standards for selected schools. In a first step the target-group are 14-year-olds. In Austria this is the transition between "Unterstufe" and "Oberstufe", when many pupils change the school type.

At this point the question arises why to establish a (at the moment only regional) standard in the field of Informatics and IT at such an early stage. The answer is based on the following theses and presumes that informatic competence is an essential part of a general education in form of a fourth cultural technique.

- Standards support the introduction of a mandatory subject Informatics and therefore should be based on a mandatory set of concrete teaching objectives.
- Standards foster the learning process, provide for a solid basis, and help prevent an early digital divide among the pupils.
- The age of 10-12 is appropriate for a first systematic education in Informatics.
- Standards provide for a solid fundament with respect to the use of ICT in other subjects as well as in forthcoming E-Learning environments

6. Resume and perspectives

Some main objectives of the project which have been described in this article have been achieved already. These are

- intensive discussions about Informatics at schools and a broad exchange of experience,
- an extensive and detailed representation of the status quo with regard to the realisation of education in the field of Informatics in the 1st and 2nd form of the Carinthian comprehensive secondary schools,
- the definition of a manageable set of clear teaching objectives as an orientationfor both teachers and pupils.

But this is not more than a first step in the right direction. Defining the teaching objectives is only half of the truth. The challenge for the near future is to ensure that the process of achieving the standards will be successful. In terms of the saying "the journey is the reward" demanding efforts still have to be taken to find appropriate strategies to fulfil the high expectations.

In the meantime measures have already been taken to provide a representative pool of material, appropriate exercises and assignments. Almost all schools involved revealed their collection of (partly unstructured) learning material for covering many items of the standard. This useful data will be categorized and structured and will be put at disposal for the schools in the form of an internet platform at the beginning of the school year 2004/05. It will be up to the didactical skills of the teachers to make appropriate use of this learning material.

The last step which completes the process of standardization, assessment, is the most important. Assessments give feedback about the competences the pupils (should) have acquired after two years of instructions in Informatics. At the moment this step is in progress.

"A standard is something set up and established by authority as a rule for the measure of quantity, extent, value, or quality [Ma04]". A far as marking is concerned a remarkable diagram as another result of the online survey among the pupils is shown next.

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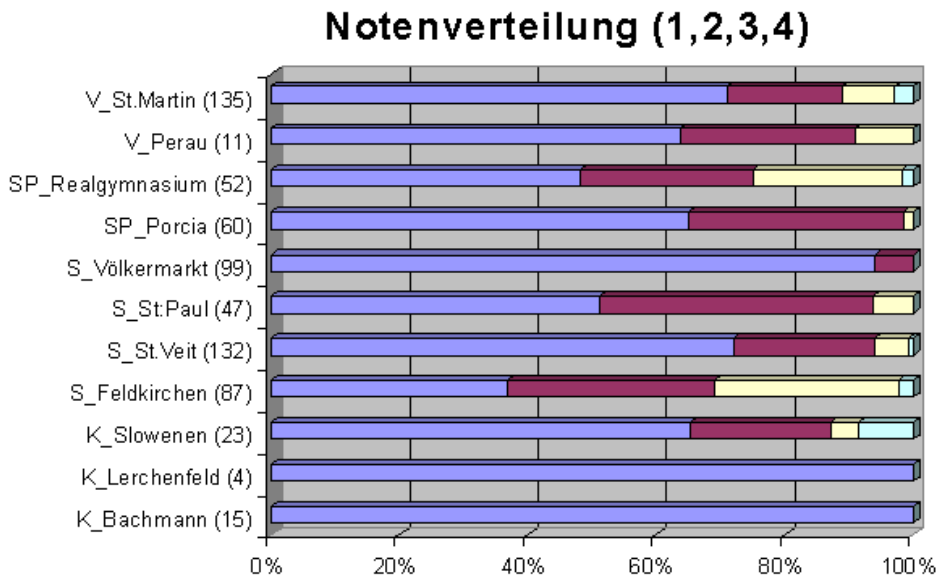

Chart 7: The distribution of the marks given in the subject Informatics in the 1th form

In Austria students are graded between 1 (very good) and 5 (insufficient). This chart obviously reveals the fact that that the teachers grade up because the marks are generally very good.

"It must be pointed out that the marks and the (real) competences often do not correspond [Bi04]". It can be assumed that Chart 7 is not really meaningful with regard to the knowledge and skills of the pupils. But the thesis that standards will lead to a better balanced distribution of marks has not been supported yet.

Literature and Weblinks

[Gu02] Herbert Gudjeons, Rainer Winkel (Hg.), Didaktische Theorien, Bergmann+Helbig Verlag, p 75 – 92

[Do04] CD Austria, Standards in der Schulinformatik, Cristian Dorninger, p 4-6

[Kl03] Eckhard Klieme et al., Zur Entwicklung von Bildungsstandards – Expertengutachten für die Kulusministerkonferenz, Bonn, 2003

[Ma04] The Marriam-Webster Online Dictionary http://www.m-w.com (June 2004)

[Bi04] http://www.bildungsstandards.de (June 2004)