Vorbemerkung:

In diesem Bericht wird eine mögliche Vorgehensweise zur Entwicklung eines schulinternen Arbeitsplans innerhalb einer Fachgruppe vorgestellt.
Der Bericht ist allerdings in Englisch verfasst, weil er im Rahmen eines EU-Projektes verfasst worden ist.
Das geschilderte Verfahren wurde im Schuljahr 2007/2008 am Hindenburg-Gymnasium (seit 1.4.2009 Humboldt-Gymnasium) in Trier praktisch ausprobiert.
Die Vorgehensweise klappte dann doch so gut, dass für alle Jahrgänge im Fach Physik inzwischen Arbeitspläne vorliegen.
Die Vorgehensweise wurde im Schuljahr 2008/09 dann mit sehr gutem Erfolg auf die Entwicklung von Arbeitsplänen im Fach Naturwissenschaften übertragen. Hierbei war die Kooperation allerdings notwendigerweise noch intensiver.

Final report for the EU-Project "Crossnet

Crossing Boundaries at Hindenburg-Gymnasium in Trier:

Improvement of individual school-lessons by a better cooperation among colleagues

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1.) Fundamental information

The Hindenburg-Gymnasium Trier (HGT) is located in Trier, the oldest town in Germany and, by the way, the most beautiful town in Rheinland-Pfalz (Rhineland-Palatinate). Trier has appr. 100.000 inhabitants and a small university with approximately 20.000 students.
The Hindenburg-Gymnasium is merely 180 years old and it has a bit more than 1000 pupils/students. It should be mentioned that our school will change its name to "Humboldt-Gymnasium Trier" in 2009. As a speciality our school offers the possibility to achieve the double exam german "Abitur" + french "baccalauréat" at the end of the education.
The physics-department of HGT consists of 10 physics-teachers (6 male and 4 female), two of them are part-time workers.
There exist 5 other "Gymnasien" in Trier. All of them have more or less the same size.
Although all of these 6 schools have slightly different profiles, the problems tackled in this project can be found more or less in all of them. We assume, that they can even be found in most schools of this type in Germany.

2.) Starting –situation and main aims of the project at Hindenburg-Gymnasium (HGT)

Two main reasons lead to the initiation of this project at HGT:

a.) Since two years our school participates in the project "Physik im Kontext". This is an initiative to improve physics-lessons by integrating innovative concepts and more daily-life-physics ("Kontexte"). Therefore in the last two years we collected some experience in developing new "contexts" for school-lessons. But only 4 - 5 colleagues benefited in some way from these activities.

During our project we wanted to establish the cooperation on a broader fundament. That means: Most of the colleagues should participate in our common efforts. And even the colleagues who were not willing to contribute should get the chance to benefit from the results. The main aims were:

1.) - **testing innovative teaching-methods,**
2.) - **introducing interdisciplinary contexts,**
3.) - **introducing the computer into the lessons in a broader approach than before,**
4.) - **developing further possibilities for practical work.**

2.) As all other schools in Germany, we have to fulfil some new standards in physics-lessons. These demands have been elaborated and written down in the so-called "Bildungsstandards" by a commission of all 16 "Bundesländer" As these "Bildungsstandards" have different aims than the so-called "Lehrpläne" which were the base of the traditional education, it results a necessity to change the way of teaching.

Additionally every school in Rheinland-Pfalz is demanded to develop a so-called "Arbeitsplan". In this "Arbeitsplan" the colleagues have to write down, how they want to realize the "Bildungsstandards" at the end of the 10th form. It shall contain common aims of the education, define main aims of instruction and it shall describe adequate methods for teaching and common ways of evaluation. As the "Arbeitsplan" has to be developed by all colleagues in common, its development automatically needs a certain form of cooperation.

The development of the "Arbeitspläne" was not very successful until the beginning of this project. No teacher was really convinced from their advantages and no one was willing to spend more time than absolutely necessary for their development. In total: No one could imagine a benefit for himself from this work.

During our project we (i.e. the authors) wanted to convince the colleagues from the advantages of developing an own "Arbeitsplan". The development of the "Arbeitspläne" for the 8th , 9th, and 10th form should be the vehicle for:

1.) - convincing them from the advantages of a certain form of cooperation,

2.) - improving the communication and the cooperation between the colleagues, i.e. exchanging materials, discussing problems and ideas, developing daily-life contexts or interdisciplinary school-lessons, ….

3.) - improving the individual lessons by benefiting from this exchange.

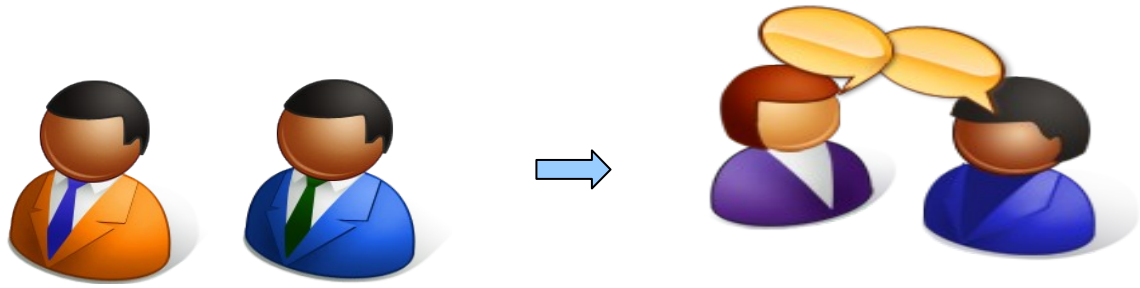


Illustration of the main aim of our project:
From individual preparation of school-lessons… to.. systematic exchange of materials and experience

In conclusion: The colleagues in our school cooperated only partly until the start of the project. One half practiced a more or less intensive form of cooperation, the other half worked for its own. Although these differences, there did not exist two fractions among the colleagues. In principle all colleagues were willing to cooperate to same extent, especially if they could see advantages for themselves. The vehicle for this cooperation should be the necessity to elaborate a common "Arbeitsplan" in a constructive and motivating way.

3.) The process of developing the "Arbeitspläne" at HGT

a.) Starting-situation

The process itself resulted from the initiative of Christian Fruböse. Annette Jonas was immediately willing to support this initiative. In a second step the headmaster agreed to the participation and he ensured general support. The physics-colleagues themselves voted unanimously for this extra-work at a Fachkonferenz in spring 2007.

As already mentioned, at the beginning of this project in spring/summer 2007 there only existed a rather brief form of an "Arbeitsplan" for the 8th form. This "Arbeitsplan" had been developed by only two teachers during a "Studientag", i.e. a day where there are no lessons but only education for the teachers themselves.

Additionally there existed “Arbeitspläne” for the 5th and the 6th form in physics/chemistry. But they are actually of no more use, as the lessons in these two forms have been completely reorganized by the ministry of education in summer 2007.

b.) Organization of the Process:

The process of developing the “Arbeitpläne” was organized by Christian Fruböse, who was “Fachkonferenzleiter” (Head of the physics-department) during this time in the following form:

- For every form, that means the 8th, 9th and 10th form there were organized 3 or 4 conferences/meetings during the school-year from September 2007 to June 2008. Only the 4 teachers, who actually teached in this special form, had to participate. This was done to minimize the work for us and to maximize the benefit for the participants at these meetings. It is quite obvious, that teachers who are actually teaching a form can contribute to and benefit from this process quite a lot.

- The members of the conferences were:

  8th form: F., R., L., J.,
  9th form: S., H., L., R. (+F.),
  10th form: J., K., K., F..

- Such an conference took at least 2 or 3 hours, in two cases even 4 hours. During these conferences the 4 teachers exchanged materials (texts, working-sheets, pictures, drawings, …) , they discussed interesting or difficult experiments or planned common projects, i.e. the organisation of practical work with the students and the experiences with the integration of the computer into the lessons. For further details, see the following chapter results.

- All contributions which were considered by all 4 teachers as being worth to become a part of the “Arbeitsplan” were instantly noted down.

- These new contributions become also part of the electronic form of the “Arbeitsplan”. This work of documentation was done by Annette Jonas or Christian Fruböse in the week after the meeting.

- The electronic form of the “Arbeitsplan” is a table, stored as an Word-document (see 3 pages later). It is combined with a long and important appendix, which contains the selected working-sheets, descriptions of very special experiments, interesting texts which cannot be found in school-books, motivating pictures or drawings etc. All these

documents were mentioned in the “Arbeitsplan” at the correct topic by hyperlinks. So the appendix and the original “Arbeitsplan” are combined directly. It is possible to get a certain working-sheet on the computer-screen by simply clicking the hyperlink in the “Arbeitsplan”. (And if there is demand, this document can immediately be printed for direct use in lessons.)

- In June 2008 the new “Arbeitspläne” were briefly presented to all colleagues in a so-called “Fachkonferenz”. Note that 2 colleagues were not involved in the whole process, as they had no lessons in one of the participating forms.

- In September 2008 the final form of the Arbeitspläne shall be presented at the Fachkonferenz once again. After a thorough discussion they shall become the base for our work in these forms for all colleagues. Till now we did not make some work compulsory. We think, that the communication itself will lead to a certain harmonization of the quality of our lessons.

In summary all colleagues contributed to the meetings by their materials or own experiences. Although the main work, i.e. the organization, the documentation and quite a lot of contributions have been done by Annette Jonas and Christian Fruböse, all colleagues contributed to the meetings with their materials and their experiences. So all 8 participating physics-colleagues were involved in the process and could profit from it.

4.) General Results

As already mentioned, for every form 3 or 4 meetings/conferences were held. As the members of all 3 forms were quite different, the way of discussion and even the topics differed quite a lot.

- In the 8th form we mainly discussed the advantages and disadvantages of certain interesting experiments. As a result many experiences about good or worse experiments were exchanged. Additionally we talked about the value and the function of certain experiments done by the students itself. As a matter of course also working-sheets were exchanged. The main result of this group was the integration of a larger number of experiments done by the students themselves into the lessons.

- In the 9th form the meetings dealt with the possibilities for using the school-book in physics-lessons. Additionally interesting calculations, home-work-tasks and experiments were discussed. A very special result was the implementation of the “hot-air-balloon-project”, see photo.

The Hot-air-ballon-project in the 9th form.

But the main topic was the improvement of the lessons in thermodynamics, which are normally neglected because of a lack of time at the end of the school-year. The improvement of the lessons in thermodynamics was the main result of this group.

- In the 10th form the cooperation was probably the most productive one. One of the most remarkable results was the new arrangement of the topics during the school-year. The lessons in this form now start with "radioactivity" and they end with "electricity". Besides this rearrangement working-sheets, tests, hints for the beneficial use of the school-book etc were exchanged. The main results of this group were the development of a sequence "physics and medicine" (see below), the integration of more practical work into the lessons in electronics (see below) and the testing of the use of the program "Crocodile Physics" (see below).

In all 3 meeting-groups the cooperation was quite productive at the beginning but it went down during the school-year. The explanation for this decrease was the extremely tight time-table in the second half of the school-year (2007/08) because of the early holidays.
It must be summarized, that although of this additional work all colleagues did it without any opposition. They considered the discussions and results as useful for themselves and the colleagues agree to continue this process in the future.

5.) Special Results

In the following as an example for the work being done during the "Crossnet-project", some results from the 10th form are presented: :

a.) Crossing interpersonal boundaries: "Arbeitsplan radioactivity" for the 10th form

The "Arbeitsplan" in all forms is built up as a table (see below) and an appendix which is combined by hyperlinks to the table. (For a larger scale have a look into the appendix.)

The table consists of 6 columns. For their presentation we start from the left. In the two left columns the demands of the old “Lehrpläne” are listed. They function as a link between the traditional aims of teaching and our future program.

In the third column (green) interesting or valuable experiments are noted down.

In the fourth column (red) interesting materials (working-sheets, tasks, internet-adresses,…) are listed. In this column one can find the majority of the hyperlinks (see for instance Rad 3 or Rad 4 in this column).

In the fifth columns methodical hints are given, which were distilled from the discussions in our meetings.

In the sixth column connections to the “Bildungsstandards” are noted down, as far as possible and useful.

Arbeitsplan Klasse 10 Physik/Fb Stand: 28.01.08					
Lerninhalte (given by ministry)	**Erläuterungen (given explanations)**	**Versuche (experiments)**	**OPO/Medien/ (media and materials) (internet)**	**Methodische und weitere Erläuterungen (methodical hints)**	**BS-Bezug** didakt. Bemerkungen (relation to scientific literacy)
Radioaktivität ca 16 Std, d.h. : Bis zu den Herbsterien. Nicht viel länger! Beachte: Voraussetzungen E-Lehre fehlen (wichtig für G-M-Zählrohr, Ablenkung r.a. Teilch. im B-Feld) Reihenfolge vertauscht gegenüber Lehrplan!					
1.)Aufbau der Atomkerne	**Kernaufbau aus Protonen und Neutronen**	Bezug zum Rutherford-Versuch herstellen	• Text: „A simple model of the atom“ (in Englisch) Rad 3 • OH-Folie zum Rutherford-Versuch (Gleiche Folie wie Chemie verwenden!) • 2 Applets zum Rutherfordversuch auf dem Labtop unter gemeinsame Dateien Rad 1 • AB zum Rutherfordversuch, passend zum Applet Rad 2 http://www.chemie-master.de/FrameHandler.php http://www.chemie-master.de/lex/begriffe/r05.html	Was wisst ihr vom Atom aus der Chemie? Elektronen lassen sich entfernen Ionen. Hülle: Chemie (chem. Bindungen wiederholen) Kern: Physik (Beschleuniger, Fusion, Spaltung, Radioaktivität) Was kann mit den Kernen passieren? Darüber lernen wir etwas (Vorwissen nutzen!)	**Fächerverbindend zu Chemie** aufgrund der Behandlung des Rutherford-Modells und des Teilchenmodells in der Chemie **Fächerverbindend zu Englisch** **Entwicklung eines Modells anhand der exp. Ergebnisse thematisieren.**
2.) Nachweis der radioaktiven Strahlung	**Zählrohrgerät, Nebelkammer, Registrierverfahren**	V: Glühstrumpf und Geigerzähler (Geiger-Zähler nur qualitativ, da E-Lehre fehlt) Evtl.: Nebelkammer	• ..... • HA: Text S. 396 Cornelsen o „ So wurde die Radioaktivität entdeckt“ oder Dorn S. 303 „Info aus der Geschichte“ Fragen dazu beantworten • AB: Wirkung radioaktiver Strahlung auf Materie Rad 5(fasst obige Texte zusammen) • Nebelkammertext im Dorn Bader S. 318	Messen kann hier mehr als das Fühlen Ängste . Wie kann ich messen – und damit erst feststellen - , dass die vorliegende Probe (nicht) radioaktiv ist? Einheiten bei Strahlenbelastung später!	**K3 und K1** Thema „Radioaktivität“ besitzt besondere Chancen für Schulung der kommunikativen Kompetenzen, weil „mathematikarm“: Textbearbeitung üben, Kurzvorträge vergeben, Chancen für Referate.

First page of the „Arbeitsplan“ in the 10th form.

b. Crossing interdisciplinary borders

Another example which can be found somewhat later in this “Arbeitsplan” is the hyperlink to a sequence of lessons dealing with physics and medicine. As the main topic is radioactivity it only deals with the comparison of x-ray-examinations with the so called γ-szintigraphy. Both

kinds of radioactivity are more or less similar, but they are applied quite different in medicine and they yield different informations. (Detailed information can be found in: C. Fruböse "Untersuchungen mit Röntgen- und γ-Strahlen in der Medizin" in "Der mathematische und naturwissenschaftliche Unterricht MNU, Heft 6, 2008.)

γ-*szintigramm of a man. Although in principle there exists no difference between* γ-*rays and x-rays, they are not taught together in school. And as both rays are applied quite different In medicine they yield different informations about the examined patient. The different form of application also leads to completely different photos: The x-ray-"photo" would be blackened just opposite than above* γ-ray-photo.

c.) Crossing boundaries in Electricity:

As an example we demonstrate two examples from our "Arbeitsplan" in electricity, where we have tried to cross boundaries by using context-orientated topics, for example the model of a drill (see photo) and a practical course in electronics (see later).

Analyzing the construction of an electric motor by exploring a drill

At Hindenburg Gymnasium all physics-teachers agree, that some practical work in physics improves the motivation of the students. As especially (older) female students are afraid of technical work, we motivate them to cross these personal boundaries. At HGT since 2007/08 each teacher can choose between two different practical courses:

1. The students examine Ohm´s law by constructing several circuits with luster terminals.
2. Each student constructs an alarm system by his own.

The complete alarm system.

In 2007/08 three classes chosed the newly established possibility of constructing an alarm system. The construction of the alarm system has the advantage, that the students see a final result of their efforts.

The course begins with a simple exercise in soldering. Thereafter each student gains his own construction kit. (Firma Opitec, ca. 4,50 € per student).

The whole construction needs a time of appr. four lessons. The students who are finished with the practical work have to deal with three worksheets. In the worksheets, they have to learn the theory of a transistor, because this component was until this time an unknown element of the system.

At the end they received one mark for the practical working in the lessons, one for their alarm system and also one for the theoretical work with the worksheets.

Let´s have a look to the remarks A. Jonas made:

- It was very inspiring to see the smiling of the students, if their alarm systems worked.
- It it not only a motivation for the students, it's also a motivation for the teacher, as one can see the students work.
- For the practical lessons it was very helpful, or better indispensable, that our technical assistant helped. It would be quite undoable for one teacher to help 30 students with their practical work concurrent.
- Beside of this, it would be better to have 90 minutes for one practical lesson and not 45 minutes.
- Finally, I can say, except one system, all of the alarm systems functioned. The motivation of the students was very high, especially of those students, who are not good in theoretical physics.

d.) Crossing boundaries to new media: The project „crocodile physics“

Another boundary we tried to cross was the implementation of new media, in our case the introduction of the program “Crocodile physics” .

The first attempt was done in a class with 29 students (17female, 12 male). We can use a computer room with 13 computers, so two students and in some cases three students have to share one computer. (It must be confessed, that it is not easy to organize the computer facilities, as in our school with 1000 students we only have two computer rooms with 10 respectively 13 computers.)

In this year we could use the room for five lessons. The course is based on four worksheets:

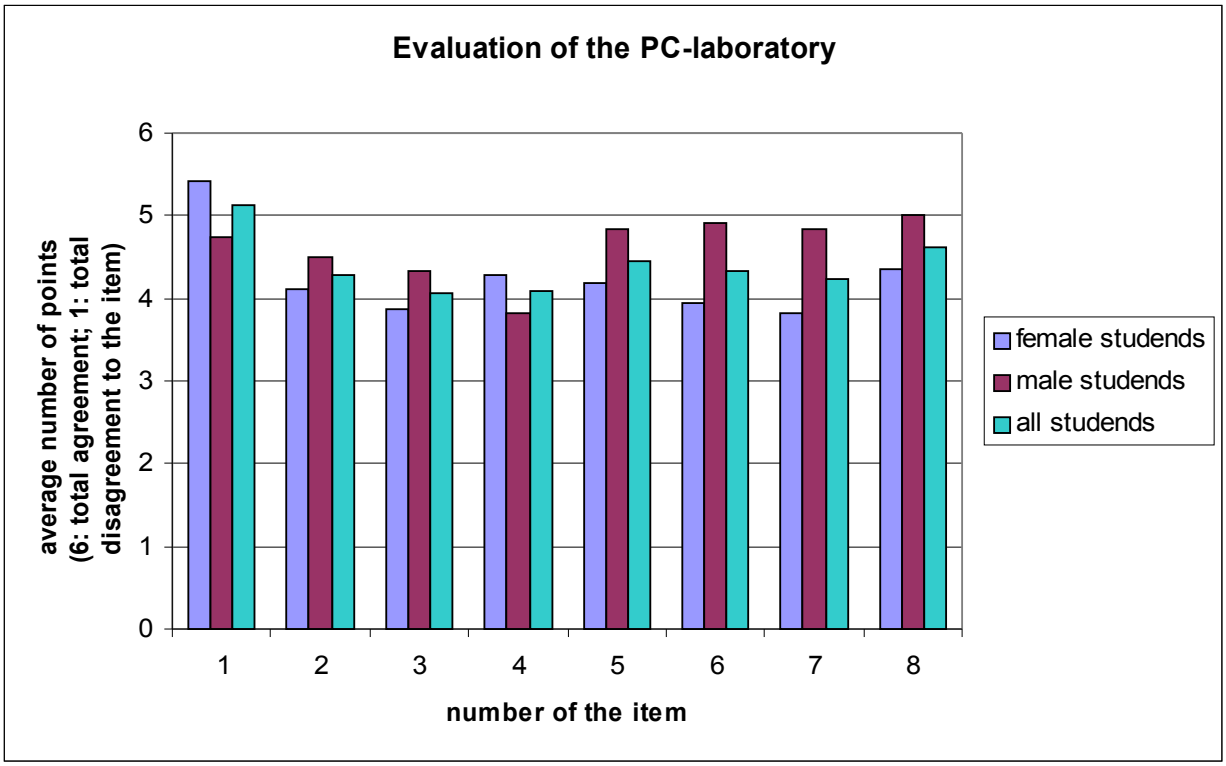
1. circuits with two or more accumulators,
2. the correlation between voltage U and current I,
3. the laws of series connections,
4. the laws of parallel circuits.

At the end of every worksheet, each student could create his own circuit and his own exercise, so a differentiation of the standard of performance („Binnendifferenzierung“) became possible. In this respect the computer-program exhibited a remarkable usefulness.

At the end of the course each student had to attend an evaluation in form of a questionnaire. There were the following 8 items in the questionnaire:

1. “The use of the program crocodile physics was a welcome change of the normal lessons.”
2. “The explanations of the program were sufficient.”
3. “I understand the tasks of the work sheets.”
4. “I‘ve been motivated by the program to learn more about electricity.”
5. “The handling of the program was ok.”
6. “I learnt the most important facts, about electric circuits.”
7. “Now I am able to create my own circuits with this program.”
8. “The program should be used more often.”

The students had to give marks from 1 to 6. (6 completely true, 0 absolutely not true). Additionally each student could express his own remarks. The students had to give points to each item. One point means total denial, six points means total agreement.
For the analysis all points for each item were summarized and the average was calculated. This was the result of the evaluation:



In total the result is rather positive. The differences between girls and boys are relatively small. Nevertheless you can see, that particularly the female students appreciate the introduction of "crocodile physics" as a welcome change in respect to normal lessons. Some useful suggestion of the female students should be mentioned:

1. The groups should contain students with better physical or technical knowledge and students with weaker qualifications.
2. More time to fulfil the tasks should be offered.
3. The location should be changed each lesson: One lesson in the PC-lab and one lesson in the physics room, to consolidate the results.

The comments of the male students concerned the demanding challenge in comparison to the normal course. And it must be confessed, that in total the male students were more experienced in using the computer.
One student wrote: „although, physics isn't my favorite subject, the lessons were very good."
Finally it has to be mentioned, that the students had to elaborate the theory by their own. And this was a really tough demand. (In normal lessons the teacher presents the main facts and he creates the panel, so it is far easier for the students to find the important facts.) To compensate this lack, we finally developed a mind-map on the blackboard containing the most important facts of electrical circuits.

In summary the integration of crocodile physics was a success, because it motivated all students, even those, who were not interested in physics.

6.) Summary and reflection

During this project an efficient and successful method for the development of the "Arbeitspläne" has been established.

As a result we have developed "Arbeitspläne" for all 3 forms. Each of them is combined by hyperlinks to an appendix, which includes a valuable collection of materials which can enrich the lessons of all our physics-teachers.

Remarkable results were obtained. As an example we mention the installation of a computer-practicum, the introduction of practical work into the electricity-lessons, the development of interdisciplinary and context-oriented lessons in radioactivity, the development of more experiments done by the students itself and finally first steps towards a better integration of the school-book into our instruction.

During this process the cooperation among all colleagues has been improved significantly. The better communication lead to an exchange of ideas and additionally it opened the door to a certain harmonization of our physics-lessons.

Although quite a lot of the work had to be done by the team leaders (and authors of this report), it can be stated, that all colleagues contributed to this project. Best of all, all colleagues are in principle willing to continue this process in the future, as long as it does not require to much time.