

**Groupe international de recherche sur l'enseignement de la physique
International Research Group on Physics Teaching
Internationaler Arbeitskreis zur Förderung des Physikunterrichtes**

No.39

November 1998



GIREP HOME PAGE: <http://www.pef.uni-lj.si/girep>

At the GIREP-ICPE conference in Duisburg, Dieter K. Nachtigall has been awarded ICPE Medal "because his remarkable contributions to physics education have been outstanding and international in their scope and influence, and have extended over a considerable period of time", as Paul Black said at the presentation of the Medal. After a career of nuclear physicist, Dieter Nachtigall has turned to physics education, first in Germany, later as visiting professor mostly in developing countries. He has been teaching physics teachers in China, Ghana, Guinea, Indonesia, Jordan, Malaysia, Mozambique, Namibia, Nepal, Pakistan, Philippines and Vietnam, he has been named honorary professor at 40 universities in China etc.. He has always tried to find a local approach and to use local resources, and has been accepted in many foreign countries because of his sensitivity to local cultures. But first of all, he tries to convince physics teachers and student teachers that they need a new self-concept, as he is telling us in his paper.

Preconceptions and Misconceptions

1. Physics Teaching Today

Physics as school subject appears to be boring, meaningless, and not useful for daily life. The reason is that most physics teachers focus on presenting the subject matter by means of definitions and formulas. They do not help learners to understand physics. Memorization has still priority over application to meaningful events. Therefore, rote learning earns good marks, but the outcomes in terms of thinking ability are meager.

This is in particular true in developing countries where I frequently teach physics teachers, in-service as well as pre-service.

The importance of physics as a fundament of science and technology demands that all young people should understand basic physics, not only to serve the job market with physics graduates, but to develop their intelligence by means of understanding physics.

Major improvements in this respect can only be made possible when physics teachers adopt a new self-concept. They should no longer be god-like information-providers who indoctrinate students with concepts they do not understand. Instead, the physics teachers should act as assistants for further developments, both intellectually and ethically. This will also include "three basic insights" of teaching and learning as follows: **(1) to present subject matter is not teaching, (2) to store stuff away in the memory is not learning, and (3) to memorize what is stored away is no proof of understanding.**

2. Preconceptions

The role of an assistant for development implies that the physics teachers should become aware of the fact that the minds of students who enter the physics class for the very first time are not like empty bottles into which "the physics" can be poured. They are already occupied by naive worldviews, simple rules of belief, primitive experiences, practical "working hypothesis", by means of which students make sense out of the result of their interactions with the environment. They are called *preconceptions* because they exist before (pre) students attend physics classes. They are deeply rooted in the students' minds. They are truly "private mental property" because their generation is

biographically determined. They are sometimes contradictory to each other, and often unconscious, but they are a common tool to handle the events in the daily-life world even though they represent just common sense and not scientific reasoning. When students are supposed to understand basic physics, their preconceptions must be transformed into physics concepts. When physics teachers want to do this with success, then they have to:

- let students listen to the different ideas of classmates so that they can see that other students explain phenomena in different ways, i.e. that they have different preconceptions,
- in this way make the individual preconceptions conscious to the students in the class,
- confront them with each other
- let students find out the contradictions among them,
- demonstrate that they often fail, in particular when one wants to make predictions,
- let students feel the need for another, more powerful and rational idea,
- introduce the physics concept, the idea first, the definition later, finally the mathematical representation which must always be interpreted,
- let students become aware of a mental conflict because the physics concept is often against the common sense and counter-intuitive,
- show that the physics concept is more powerful, explains more, has a longer range of validity and allows - first of all - quantitative predictions,
- create, in general, an environment whereby the students can develop strong conceptual understanding of physics through application of physics concepts to everyday phenomena,
- come to a consensus in the class regarding the superiority of the physics concepts compared with the preconceptions by emphasizing rationality.

1. Misconceptions

Physics teachers often claim that it is too time-consuming to discover and transform the preconceptions. They claim that they must cover textbook content and syllabus and cannot discuss the "crazy", "wrong", "stupid" ideas appearing in the preconceptions. They think that wrong things should not be subject to discussion in class. After all, the only truth in physics is what is written in the textbook. This and only this must be lectured, copied and memorized and everything else can be forgotten.

This classical "paradigm of teaching" fails, because physics concepts, taught in this way, are normally not or poorly understood and the home-made preconceptions may well survive all physics courses given in this unscientific way. The result of this kind of "giving lessons" is just that students do not really learn *physics* but only memorize physics *vocabulary*, and remain on the preconceptional level of explanation. When they have to solve real problems in physics, they express their preconceptional thinking by means of this physics vocabulary and the outcome is what is called *misconceptions*. This can be avoided by using the procedure described above.

The generation of misconceptions is certainly not the goal of teaching and learning physics. In order to become more successful in their profession physics teachers must be confronted with many samples of students' preconceptions, whereby they may discover that they themselves have preconceptional thought structures that dominate their physical thinking. With other words: they may discover that they as physics teachers

have misconceptions. This could be a helpful shock-therapy when it prepares them to agree upon the "three basic insights" of teaching and learning introduced in the first paragraph. Of course, it will still be a long way until they implement into their own self-concept convincing answers to the questions.

- What is teaching physics?
- What is learning physics?
- Understanding physics - what does this mean?

Making the process of transformation of preconceptions into physics concepts a self-evident procedure, thereby avoiding the generation of misconceptions, is the very basis of creating a new paradigm of teaching physics.

D. K. Nachtigall

Research Interest Group - Computers and Physics

The application of computers to physics teaching has been growing steadily for several years as microcomputers have become more affordable in schools. Of particular interest has been the development of data-logging applications, or MBL, in which the computer has become a valuable tool for physical measurement and analysis. As with many other computer developments, the quality and ease of use of software and hardware available in this field have progressively improved, but not all such developments have been adequately informed by pedagogical principles. Although there is a general sense amongst curriculum planners and innovators that data-logging is a good thing for education, the principles which underpin this view need clarification. One of the problems appears to be the relative scarcity of rigorous research into the educational benefits of data-logging, and much of that published in the literature appears to be rendered obsolete by rapid technical innovations in the hardware and software available.

I am interested in exchanging ideas with colleagues in physics education with a view to collating and disseminating information about research into the educational benefits of data-logging where the research context features up-to-date software and hardware. I have in mind that there are colleagues who may be interested in forming an interest group which would initially communicate via e-mail and later organise a seminar. It would be valuable to draw from experience across many countries against the background of different educational traditions. If you have read about or conducted and published recent research in this field and would like to encourage professional debate of the issues please contact me to register your interest.

Laurence Rogers
lto@le.ac.uk

School of Education, Leicester University, Leicester, LE1 7RF, UK

**Report on the GIREP/ICPE Conference
'Hands-On Experiments in Physics Education',
August 23 - 28, 1998, Duisburg/Germany**

For the second time, after 1972 in Kiel, a regular GIREP conference was held in Germany. In 1992 I proposed 'physics toys' as a topic for a conference to our former president George Marx. This theme was accepted at the GIREP General Assembly in Udine in 1995. The organization committee for the conference in Duisburg broadened the topic to 'Hands-On Experiments in Physics Education' since this more general title allowed not only more contributions but also better financial support. The University of Duisburg was chosen as the location for the conference. Gernot Born, Horst Harreis and Norbert Treitz, all professors at this university and members of the organization committee had already successfully organized an ICPE conference on 'Communicating Physics' in 1985. Their experience and connections were of great advantage.

The facilities at the University of Duisburg could not provide for more than 300 participants, due principally to the capacity of the lecture halls. We stopped the registration process as soon as 350 registrations. This meant that additional interested persons could not attend. About 300 people from over 40 different countries from all the continents except Australia were actually present.

The structure of the conference was more or less classical, meaning a mixture between plenary lectures, panel sessions, invited and contributed workshops, poster sessions and a social program. We tried to focus especially on workshops, poster sessions and small contributions with low-cost hands-on-experiments. Consequently, there were not as many plenary lectures. Nevertheless, plenary lectures are the highlights of a conference and that is why I would like to mention the nine invited plenary lectures in some detail.

Ron Edge/USA started with 'String and sticky tape - and other fun-experiments'. He presented interesting experiments, most of which have been described in his column in the American journal 'The Physics Teacher'. Within minutes after his lecture began, the whole audience was sharing in his noisy experiments.

Lutz Fiesser/Germany, director of the Science Center Phaenomena in Flensburg in Northern Germany, talked about 'Hands-on experiments in science centers - aren't they really brain-on?' He described the great variety of hands-on experiments to be found in science centers.

A public evening lecture entitled 'An Entertaining Lecture on Physics Toys' was held by Wolfgang Buerger/Germany. He talked about more or less well known physics toys, didn't mention too many formulas, showed many toys and elucidated them with entertaining stories. About 700 listeners applauded his lecture.

Ranga Yogeshwar is a physicist and head of the science department "Quarks & Co." of a public television company in Germany (WDR). In his lecture 'The Colour of the Electron - Science and Media' he demonstrated the enormous possibilities of the new media and illustrated his talk with experiments from his television shows. On that same evening there were more demonstrations from his collaborators in combination with a buffet dinner.

Luo Xingkai from the Guangxi Normal University in Guilin/China talked about ‘Educational considerations for designing, selecting and using hands-on experiments’. His reflections and demonstrations gave an insight to some of the difficulties which arise in developing experiments and using them in teaching.

Cecylia Iwaniszewska from the University of Torun/Poland showed in her lecture ‘Hands-on Experiments in Astronomy’ how even young children as well as adults could learn basic facts about astronomy through ingenious low-cost experiments.

George Kalkanis from the University of Athens/Greece described many toys found in pictures from old Greek vase decorations in his lecture ‘The Physics of Ancient and Modern Greek Folk Toys’. Some of these Greek folk toys are well known in other countries also.

John King from the Massachusetts Institute of Technology (MIT)/USA described his ten years of experience with this type of laboratory in his talk ‘Quantitative Experiments in Mechanics and E&M from Low Cost Take-home Kits’.

Almost the entire spectrum of physics could be found between the topic ‘Teaching Science with Toys at Miami University: An Effective Model for In-Service Teacher Enhancement’, presented by Beverley Taylor from Miami University in Hamilton/USA, and ‘Hands-on Quantum Mechanics’ by Dean Zollman from the Department of Physics at Kansas State University/USA. Each of the lecturers showed experiments and combined them with reflections about the topic.

Ten invited workshops formed a very important part of the conference. Participants could actively take part in experiments and take home a collection of papers, toys or low-cost experiments from various fields of physics. It would take much too much space to describe the topics of all the workshops in detail.

In four parallel sessions more than 120 contributions were presented in 20-minute talks. 11 contributed workshops with a broad range of topics were also held.

The social program consisted of visits to the Roentgen (X-Ray) Museum in Remscheid nearby Duisburg, the old town of Xanten and a big steel plant. An evening tour on a tourist excursion boat on the Rhine River was one of the highlights. Luckily there was no rain. We enjoyed a fantastic buffet as the sun set.

Christian Ucke

The International Anthem for GIREP'98

prepared by the participants of the conference,
organised and collected by Laurence Rogers and Jan Dunin-Borkowski

UK

Bells are ringing, trumpets sounding:
"Join GIREP ninety eight"
Bring your toys and get your hands on,
With them physics will be great!

F

Choses petites, choses grandes,
Touts se passent à Duisburg,
Plus facile à apprendre
La Physique tout le jour.

Small toys, large toys
They are all here in Duisburg.
It is easier to learn
Physics all the day long

PL

Doswiadczenia i zabawki
To fizyki nowej prad.
Na GIREP-ie w Duisburgu
Przyszlej szkoly tworzymy zrab.

Experiments and toys
It's a new strand of physics.
On the GIREP in Duisburg
Let's build the school of the future

D

GIREP gehet nun vorüber
Zeit des Austausch bald vorbei
Was auch immer wir erfahren
Mög es reifen dann zu haus

GIREP soon comes to an end
Time for exchange passes quickly
So whatever we have learned
May it ripen at home

Jap

Yuki yo, I wa yo
Warera ga yadori
Oretachiya machi ni wa
Sumenai karani

To the snow, to the rocks
To the mountainside
As we return to our home town
We bid farewell to the city

E

En el GIREP de Alemania
En la cola yo ti vi
Y España os espera
Cuando llegue el dos mil

At GIREP in Germany
I saw you in the queue
When 2000 comes
Spain waits for you

I

Hai computers, hai le mani
Ma non hai capito ancor
Che la Fisica che tu vuoi
È la Fisica del toy

With computers, with hands
But not without our heads
That is the physics I love
The physics with its toys

CZ

Fizika je krásná veda
Jeste Hezct s hrackami
po GIREPU v Duisburgu
Zacne rozvoj na zemi

Physics is a beautiful knowledge
And more exiting with toys.
After GIREP in Duisburg
The development will spread to the world

SLO

Strela sviga, tlak se dviga,
skripec cvili, voda vre,
siti smo zdaj teorije,
z igracami nam boljje gre.

Lightening flashes, pressure rises
Pulleys screech and water boils
We have enough of theory
We can do better with toys

H

O te dragá szép fizika
Bar tudnám linyeged
GIREP által szervezeten
Veled élem életem

Oh you dear physics,
as I learn more of your essence,
through our fellowship in GIREP,
you make my life complete.

Rus.

Pust schitáyut chto nauke
Tyagelo detey uchit
Ne dadim toske I skuke
Nashe delo pogubit

Some people have the idea
That it is difficult to learn science
But our ideas do not allow
Our physics to become boring

Thai

Ma ma ruam gan, rao ma ruam gan
Ruam cha rong garn pra choom
Garn suk sa physic GIREP
Pe gao paed sing ha kom

We all come together
We come to celebrate
Physics education at GIREP
In August ninety eight

Greek

Μια ειχε ζεστη μια ειχε κριο
Μια εριχνε πολλη βροχη
Μα η φυσικη απ το Duisburg
Ζεσταιυη ολη τη γη

Sometimes hot, sometimes cold
Sometimes raining
But physics in Duisburg
Makes the whole earth feel warm

NL

Hier in Duisburg, waren we samen
Om te spelen met uns hand
De natuurkunde werd zo Duidelijk
Als de zon dit jaar op 't strand.

Here in Duisburg we were together
To play with our hands-on
Physics became so clear
As the sun this year on the beach

China

Ling'er Xiangliang, Gesheng Youyang,
98 Xianghui Laiyin Hegan
Lingqiao wanju peng zai shuo shang,
Wuli Jiaoyu da fayang.

Bell ring aloud, song sound melodious,
We meet at the riverside of Rhine in 98
With the elegant toy in the hands,
to meet the physics education booming

Report from the General Assembly on August 26, 1998 in Duisburg

written by GIREP secretary Seta Oblak

60 members present

1. Reports of the Committee

In 1997 and 1998, 3 Newsletters have been published. A new logo has been prepared. On GIREP home page, the history has been completed. Also, there was cooperation with European Forum of Education etc.

Report of the treasurer is on a special page.

2. Paul Black and George Marx were elected honorary members of GIREP; according to the Art.5 of the Statute, they will have all members' privileges and no duties.

3. Since the next GIREP conference will be in the year 2000, the Assembly agreed that the committee works on until that time; only the president is not able to prolong his mandate. The proposal of the committee was that a new president shall be elected now, that he shall start working in 1999 and stay president at least until year 2002 (presidential time 3 years). That implies a shift in the elections of the president and the rest of the committee: new committee members will be elected in 2000 for 4 years, new president will be elected 2002 for 4 years. The assembly voted and the majority decided that such a shift in the elections is good for the work of the committee.

The proposed candidate Manfred Euler was elected president from 1999 till 2002.

4. The majority of members present agreed that the members' list should be put on internet and that there should be one password for all members. The password will be published in the next Newsletter. All members will get a form to fill in, and if they agree that their data be published, they shall send it to Slavko Kocijancic who will be maintaining the GIREP home page until the next conference; his address is Slavko Kocijancic, Faculty of Education, Kardeljeva ploscad 16, 1000 Ljubljana. The form will also be on internet.

5. Discussion about Newsletter: GIREP members are interested in reports about physics education in different countries, in small teaching ideas, reports about international projects, informations about conferences etc. Contributions are called for, and in each Newsletter, the last date for sending new contributions will be published.

6. Future activities.

Conferences:

GIREP gives moral support to the conference in Guilin, China; information about it will be published in the next Newsletter.

Next GIREP conference will be in Barcelona in the year 2000.

In the year 2002, GIREP conference in Lund, Sweden was proposed.

Local intermediate conferences are welcome; GIREP committee will discuss the proposals and give them moral support.

Other activities:

cooperation with European Forum on Physics Education

cooperation with ICPE: publications of GIREP Proceedings on internet

Report from the treasurer:

I give here only an overview about the financial situation. The GIREP auditors (Silvia Pugliese-Jona and Benito Laiz-Castro) have approved every year the exact balance of the treasurer.

From August 1996 (before the conference in Ljubljana) to August 1998 (before the conference in Duisburg) there was a total income of DEM 9900. There were expenses of about DEM 13000 (2600 for proceedings Udine; 3000 for proceedings Ljubljana; 7000 as support for the conference in Duisburg; 400 smaller expenses).

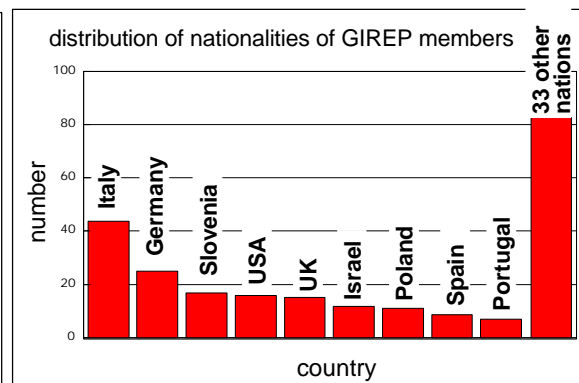
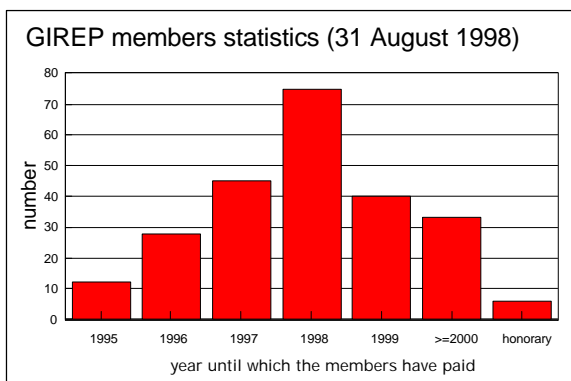
On the GIREP account there were in August 1998 DEM 5000. Every year we have an income of about DEM 5000 (which is roughly equivalent to 150 paying members!). In August 2000 there will be roughly a sum of DEM 15000 on our account.

The budget for the next two years (in DEM):

printing and mailing GIREP-newsletters	2000
conference support Barcelona 2000	7000
buying and mailing proceedings Duisburg	3000
expenses treasurer (account) and other	500

total	12500

According to the records of the treasurer there can be shown two graphs:



Christian Ucke, Munich/Germany (honorary treasurer of GIREP)

IUPAP sponsored international conference in China

**TURNING THE CHALLENGE INTO OPPORTUNITIES:
the Historic Mission of Physics Teacher for the Next Millennium**

'99 International Conference of Physics Teachers & Educators
19-23 August 1999 in Guilin, P. R. China

**Conference homepage: <http://www.cpenet.org/e-hy-99icpt.html>
or <http://www.gxnu.edu.cn/ipe/99icpt.html>**

TOPICS:

- Why, what and how should school physics be taught in a changed and changing society?
- Enhancing interest and relevance in physics teaching and learning: Enjoying ourselves and having our students enjoy themselves in the teaching and learning of physics.
- Improving classroom practices using the results of research in science education.
- Using information and communications technology in school physics and teacher education programs.
- Promoting effective communication and collaboration among practicing teachers and teacher educators.

Registration fee: 150 USD for a full participant and 50 USD for an accompanying person.
The conference language is English, but on some occasions another language may be used and an interpretation service will be provided.

CONTACT:

Prof. LUO Xingkai, Institute of Physics Education, Guangxi Normal Univ., Guilin 541004,
P.R. China, Fax: 0086-773-5818071, E-mail: xkluo@mailbox.gxnu.edu.cn

To all GIREP members:

**Please send contributions for the next GIREP Newsletter
until 30 January 1999**

Please look at our home page and fill in the members' form!

Proceedings from the conference in Duisburg will be published in a printed form and as a CD-ROM. All GIREP members who did not attend the conference should please write explicitly to the treasurer which version (printed or CD-ROM) they want to have. GIREP can afford only to send one version. If there is no reaction we will send the CD-ROM version!

GIREP COMMITTEE

President: *Karl Luchner*, Sektion Physik, Universität München, Schellingstrasse 4, München D-80799, Germany (tel 49 89 2180 3174, fax 49 89 21803391)

Vice-presidents: *Marisa Michelini*, Dipartimento di Fisica dell'Università, via delle Scienze 208, 33100 Udine, Italy (tel 39 432 558 208, fax 39 432 558 222, e-mail: Michelini@fisica.uniud.it),

Ian Lawrence, King's School, Worcester, WR1 2LH, UK (tel 44 1 905 613908, fax 44 1 905 25511, e-mail: Ian@kingphys.demon.co.uk)

Secretary: *Seta Oblak*, Board of Education, Poljanska 28, 1000 Ljubljana, Slovenia (tel 386 61 1333266, fax 386 61 310267, e-mail: Seta.Oblak@guest.arnes.si)

Treasurer: *Christian Ucke*, Physikdepartment E20, Techn. Universität München, D-85747 Garching, Germany (tel 49 89 28912399, fax 49 89 28912338; e-mail: ucke@e20.physik.tu-muenchen.de)

FEES

The accounting year runs from January 1 to January 1. Fees paid after September in any year will be credited on the following year, unless the applicant specifies otherwise.

The current fee (1996) is 12 GBP (GBP = British Pounds Sterling) or USD 18, preferably paid into the following account:

Christian Ucke, Postbank (GIRO) Muenchen, Account No. 355 28-808, BLZ 700 100 80.

BLZ (= Bankleitzahl) means a special sort of code for the Postbank in Germany.

Please do not pay into other accounts.

The members should pay their own bank charges and mailing costs. At the same time, please send a note (by letter, fax or e-mail) to the Treasurer, confirming how much money you sent and when and for what years.

In some countries, it is possible to transfer money from the national **Postbank** with EUROGIRO free of charge (Belgium, Germany, Japan, Luxembourg, Switzerland, Spain) or with a small charge (Denmark, Finland, France, Great Britain, Netherlands, Austria, Sweden).

If you send a EUROOCHEQUE filled out in DEM, there are no expenses at all for the Treasurer. If you send a cheque filled in your local currency, there are DEM 3 expenses for the Treasurer. Please do not send cheques drawn on a bank from your country (except UK) but filled out in GBP (horrible expenses then).

It is also possible to pay by credit card (EURO-/MASTERCARD or VISA; no others). Please write or fax to the Treasurer your full card number, expiration date and the amount. Add 5% expenses to the amount. The Treasurer will convert that amount into DEM and then charge your credit card account in DEM. It is not recommended to use e-mail for sending credit card numbers.

If you prefer to reduce bank expenses, you may pay several years fees in advance.

In cases of real difficulty to arrange payment, please contact the Secretary or the Treasurer who are ready to advise whether special arrangements can be made.

The last General Assembly of GIREP members in Udine (August 1995) accepted the following supplementary new article for the GIREP statutes:

Each year in October, those members who have not paid for the previous two years will be removed from the membership list.

Italian members: There is no more special arrangement for Italian members because of the new possibilities.