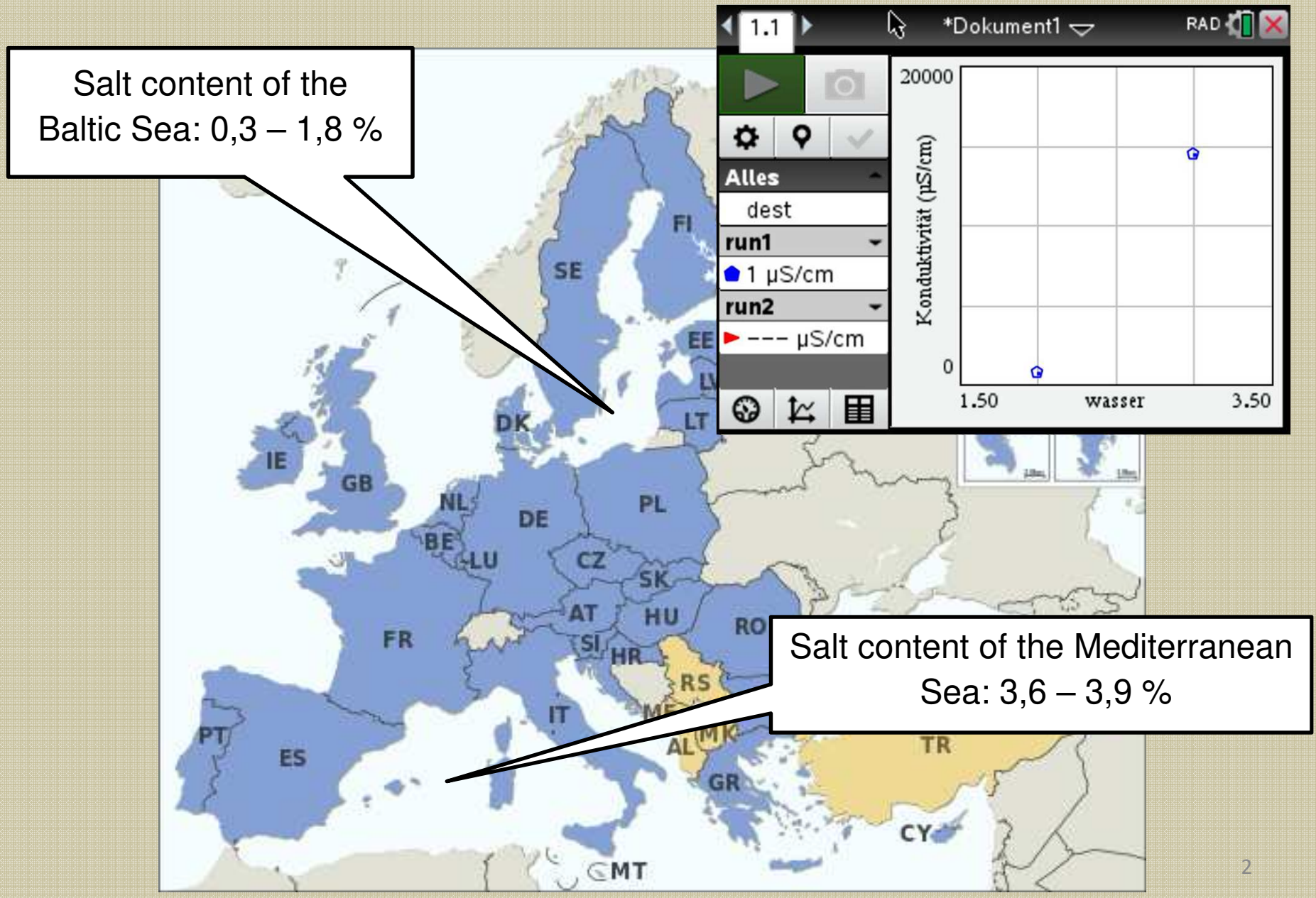
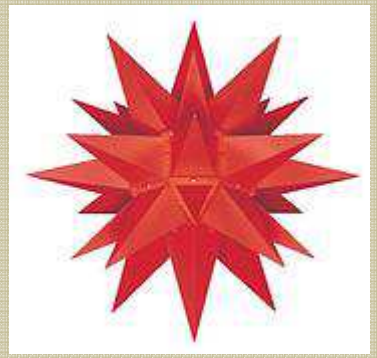
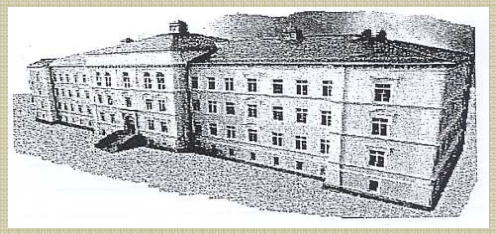
# From lessons to high school graduation exams – using digital media in Saxony´s high schools

# How well do you know the EU?





Geschwister- Scholl-Gymnasium Löbau

Frank Liebner, Herrnhut

Supervisor for Chemistry in the local school district (East Saxony)

Coordinator of the natural sciences group of $T^3$

# Why do teachers use digital instruments?

## Requirements

- Political requirements
- Curriculum
- Training for teachers
- Financing

## Motivation

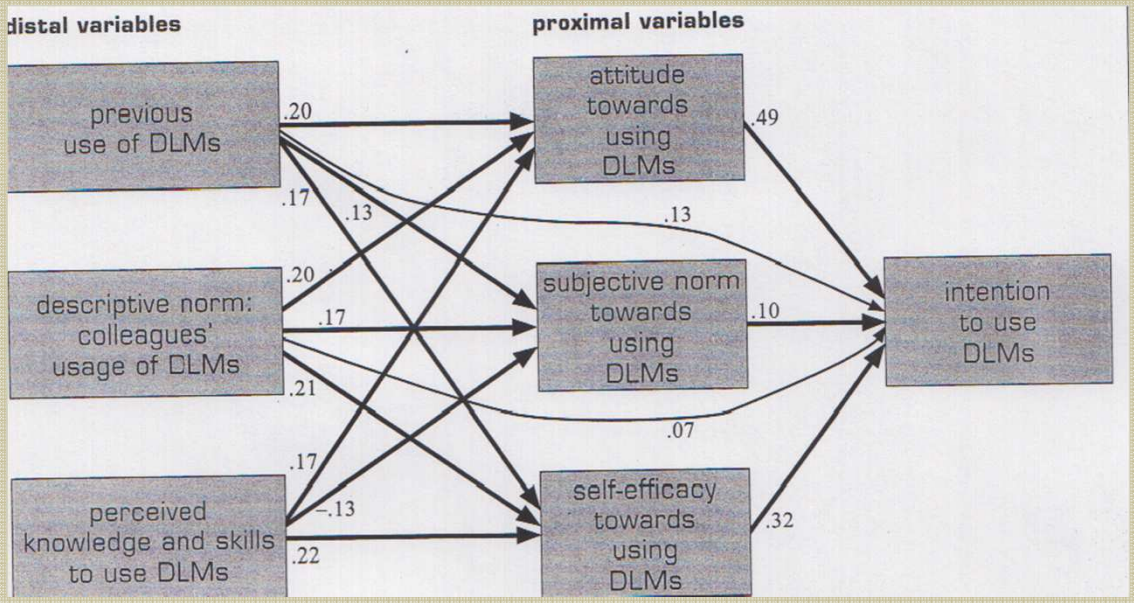
- Convinced that they make sense
- Fun in using them
- Acceptance by collegues and pupils

- Teaching materials
- Tasks in the state exams

# Why do teachers use digital instruments?

Pallack, A; Themenheft MNU; 2014

What motivates teachers to integrate ICT in their pedagogical practices? (2013; Niederlade)




## Main observations

Perceived knowledge and skills + self-efficacy towards using

Colleagues usage + attitude towards using

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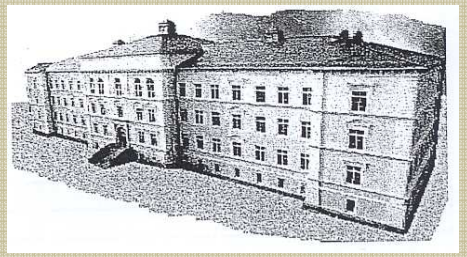
# A first experience with a group of 10 students in after class lessons during 2008/2009



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TEXAS INSTRUMENTS

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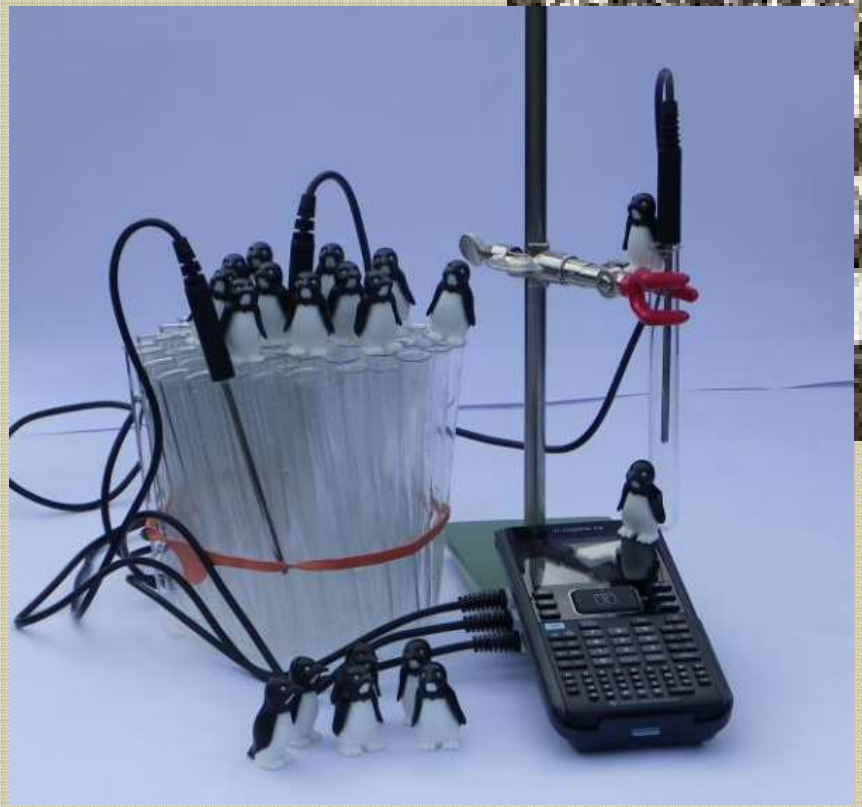
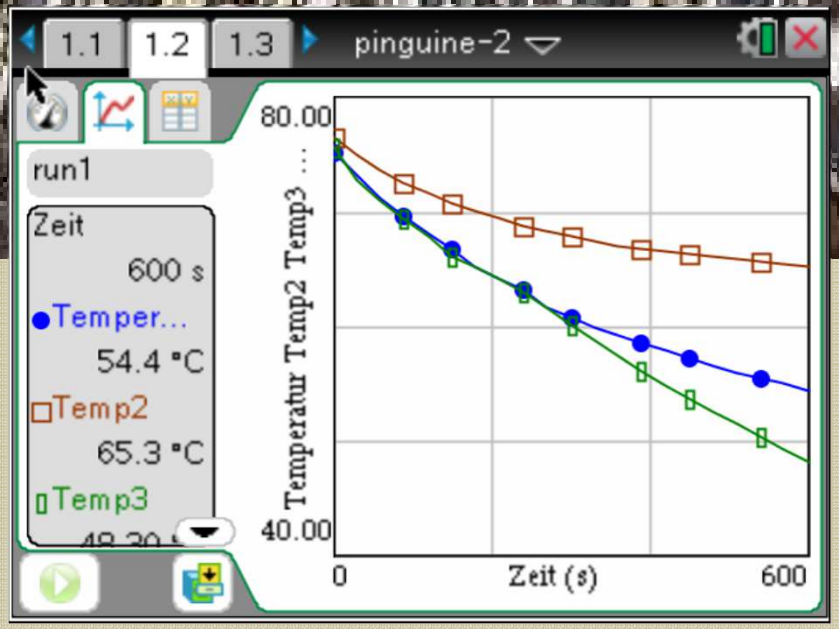
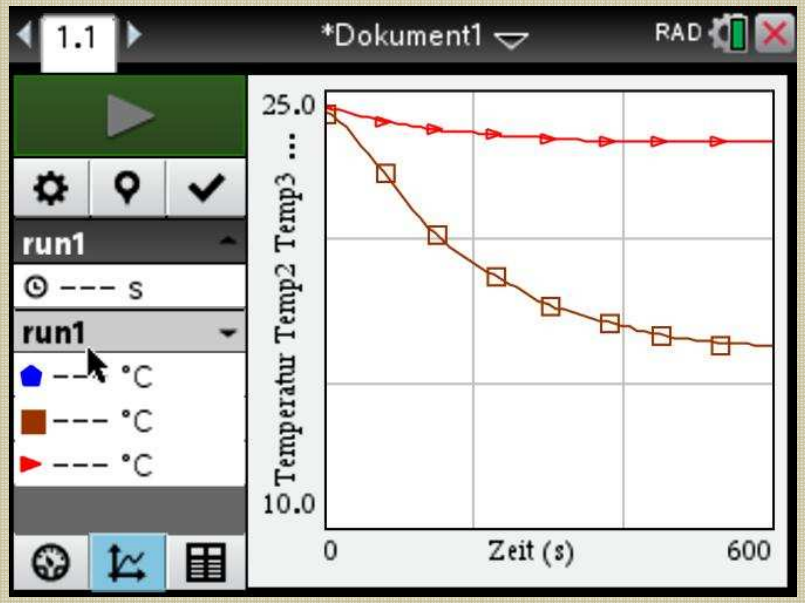
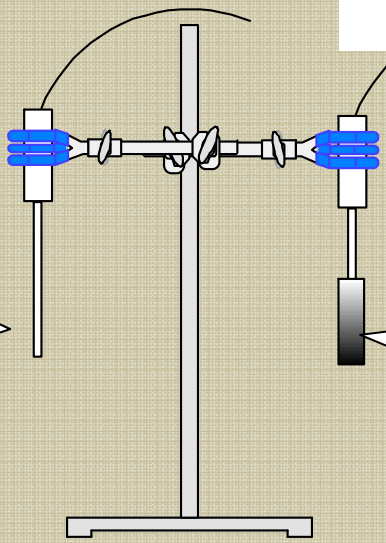
What are the penguins doing ?





True or false?
Are refreshing towels really refreshing?



Temperature sensor without a refreshing towel

Temperature sensor with a refreshing towel


The towels contain alcohol which evaporates, and heat is needed for that.
You can do this experiment with a lot of different solutions for example.
The cooling is different in each case and allows statements to be made about the intermolecular forces.
This experiment is suitable for the analysis of intermolecular forces in chemistry.

## A first experience with a group of 10 students in after class lessons during 2008/2009

### Ideas and content

Students made various experiments using different sensors. For example, they used a temperature sensor and a conductivity sensor.

After 20 lessons (20 different experiments) students got a questionnaire with various questions.

**Some results:**

Students

- had no problems with the instruments and the software.
- had a lot of fun doing the experiments.
- understood the content of the experiments and were able to evaluate them.
- needed some help though with the interpretation of the graphs.

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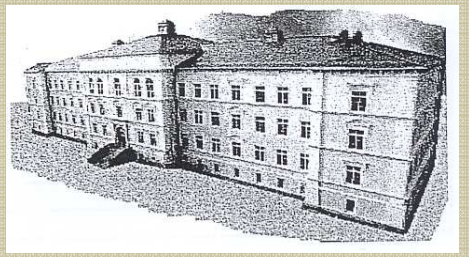

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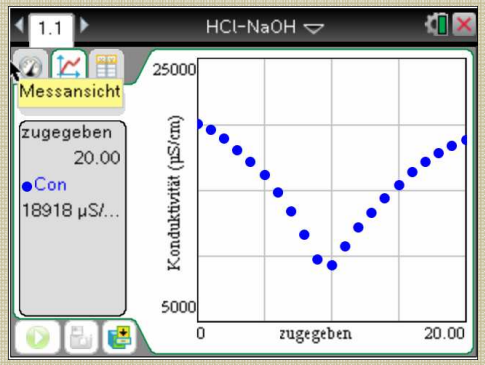
# The first study:
# „Collecting data using a calculator in basic chemistry lessons during the year 2009/10“




TEXAS INSTRUMENTS

2009/10; 368 students (grade 10) from 7 different high schools in Germany

## Curicculum Chemistry Saxony grade 10

| Learn a selected analytical method | Student experiment |
| --- | --- |
| – Experimental procedure of titration of monovalent acid- and basic solutions<br>– Evaluation of titration | acid- and basic titration, conductivity titration<br>use of computers or calculators for recording and evaluating measured values |

## „Collecting data using a calculator in basic chemistry lessons during the year 2009/10“

**Examples for possible questions:**

- What do students say about the pros and cons of using the calculator as a measuring instrument ?
- How helpful are the data graphs for the students for interpretation of experiments and finding out rules and laws of nature in Chemistry ? ….


## „Collecting data using a calculator in basic chemistry lessons during the year 2009/10“

**Summary of results:**

- The students evaluation was very positive
- between boys and girls there was only a small difference in the results
- between students from the ninth and tenth grades there was predominantly no difference in the results
- but they had some difficulties in the interpretation of the graphs

⇒ a discussion over the results was and is always necessary

⇒ it is also necessary to develop skills in interpretation of graphs

⇒ and more frequent use of measuring instruments would be helpful

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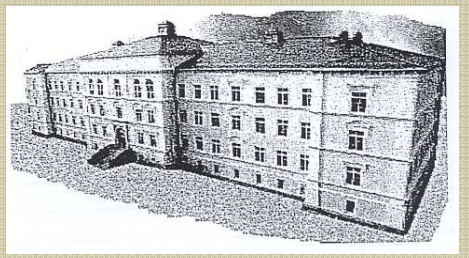

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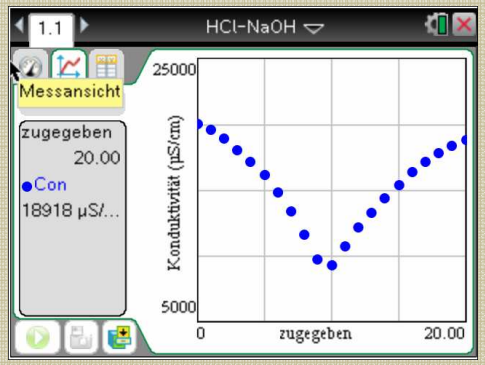
# The second study:
# „Collect data with calculator in basic Chemistry lessons in the year 20011/12“




TEXAS INSTRUMENTS

2011/12; 285 students (**grade 8**) form 7 different  High Schools in Germany

## Results of the studies

- The study showed that the use of sensors in classrooms can be helpful to elaborate and illustrate scientific phenomena and laws.
- Students worked mainly independently.
- It is necessary to discuss the results of the experiments.

# Why do teachers use digital instruments?

## Requirements

**Political requirements**

**Curriculum**

Training for teachers

Financing

Teaching materials

Tasks in the state exams

## Motivation

Convinced that they make sense

Fun in using them

Acceptance by collegues and pupils

# Chemistry curriculum for high schools in Saxony

Grade 10

| Learn a selected analytical method | Student experiment |
| --- | --- |
| – Experimental procedure of titration of monovalent acid- and basic solutions<br>– Evaluation of titration | acid- and basic titration, conductivity titration<br>use of computers or calculators for recording and evaluating measured values |

Grade 12

| Mastering the titration | use of computers or calculators for recording and evaluating measured values |
| --- | --- |
| - Experimental procedure of titration with tracer and conductivity sensors | |

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**State Teacher Training**

**Teachers Teaching with Technology**
A project for further education

Lfbz Leipzig-Jena

**Training Center for Chemistry Teachers**
Leipzig/Jena

**Naturwissenschaftliches Zentrum des Lehrerfortbildungsprojektes T³**
Geschwister-Scholl-Gymnasium Löbau - Pestalozzistraße 21 - 02708 Löbau - http://www.gymnasium-loebau.de/

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**T³ Deutschland**

http://www.t3deutschland.de

Lfbz Leipzig-Jena

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## Requirements

- Political requirements
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- **Financing**

## Motivation

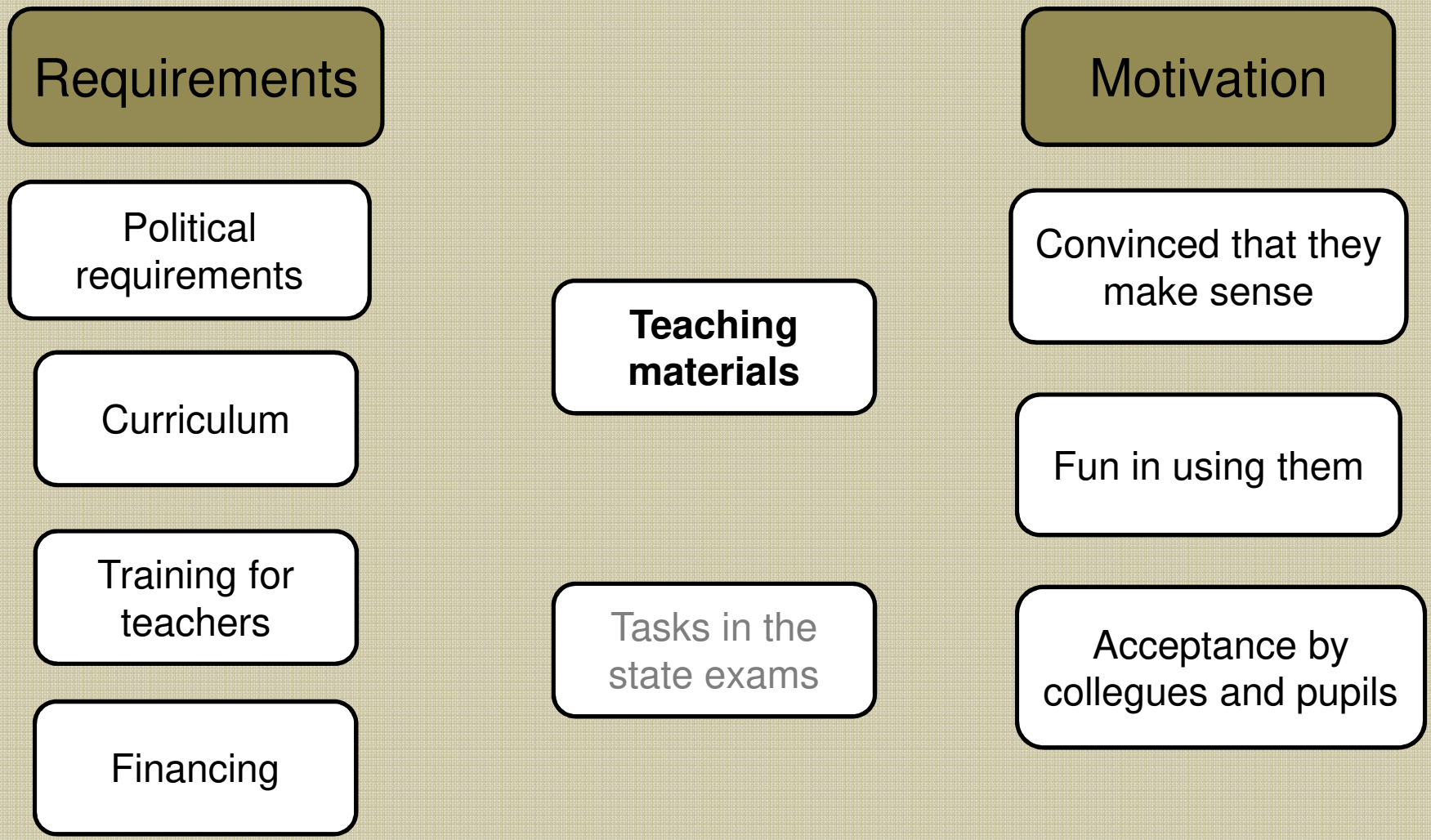
- Convinced that they make sense
- Fun in using them
- Acceptance by collegues and pupils

- Teaching materials
- Tasks in the state exams

- Schools should develop a concept for using digital media
- Financial assistance through the goverment
- Public foundations, for example, Association of the Chemical Industry

FCI
FONDS DER CHEMISCHEN INDUSTRIE

# Why do teachers use digital instruments?

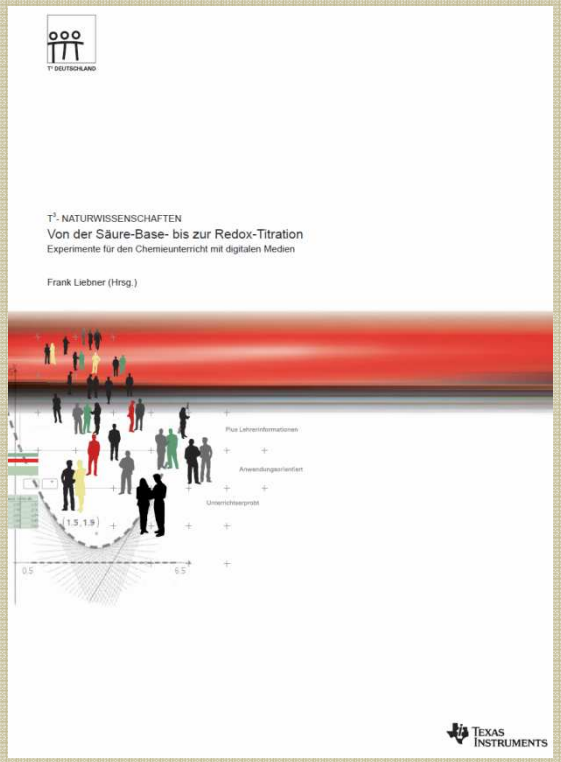


Von den Massenproportionen bis zur NERNST-Gleichung

Von der Säure-Base bis zur Redoxtitration

Naturwissenschaftlichen Phänomenen auf der Spur

Von der Reaktionskinetik bis zur Elektrochemie





http://www.ti-unterrichtsmaterialien.net

# When do teachers use digital instruments?

**Requirements**

- Political requirements
- Curriculum
- Training for teachers
- Financing

- Teaching materials
- **Tasks in central exams**

**Motivation**

- Convinced that it makes sense
- Fun at work
- Acceptance by collegues and pupils

**Written High School Exam in Chemistry (A-Level-Examination)**
**Second Exam 2013/14**

**Part A:** To be done first using the Periodic Table only (60 minutes)

**Part B:** Complex tasks (students can use a calculator and a formula sheet)

**Part C1 and C2:** Experimental parts (students can choose between two experiments and they can use a calculator and a formula sheet).

Students have to carry out simple experiments.
It may be that students will use measuring instruments which they have already used in lessons before the examination.

Teachers will receive information about the experiments some days before the examination, enabling all the experiments to be prepared.

## Task C2

You are to determine the equivalence point in an acid – base – **titration using a conductivity probe.**

1 Determine experimentally the concentration of the given hydrochloric acid solution by conductivity titration.

Use for the titration 100 ml analysis solution. Sodium hydroxide solution ($c = 1\ mol \cdot l^{-1}$) is the standard solution.

Construct on the basis of your measured values, a titration graph and determine the equivalence point. Calculate the concentration of the hydrochloric acid.

2 Interpret the titration graph by using the values of the molar conductivity of ions.

$\lambda_\infty(H_3O^+) = 350\ cm^2 \cdot \Omega^{-1} \cdot mol^{-1}$
$\lambda_\infty(OH^-) = 197\ cm^2 \cdot \Omega^{-1} \cdot mol^{-1}$
$\lambda_\infty(Cl^-) = 76\ cm^2 \cdot \Omega^{-1} \cdot mol^{-1}$
$\lambda_\infty(Na^+) = 50\ cm^2 \cdot \Omega^{-1} \cdot mol^{-1}$

3 Calculate the mass of sodium hydroxide to produce 500 ml of standard solution from task 1.

# Task C2
# (for teachers)

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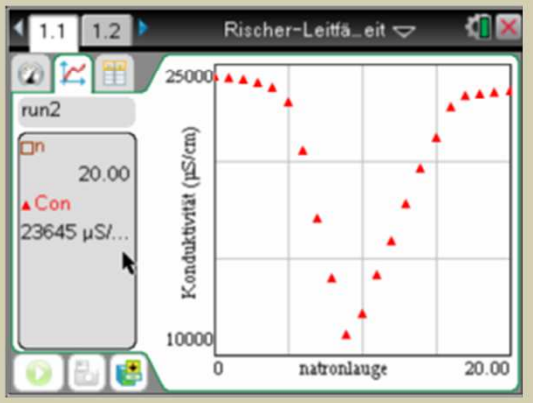
1 – execution

- titration graph
- equivalence point
- ….





2 – high conductivity at the beginning of the titration because of the available ions, especially the hydrogen ions
- at the addition of sodium hydroxide the conductivity goes down because the hydrogen ions are exchanged for sodium ions with a smaller conductivity
- at the equivalence point the conductivity is at a minimum because of there are only sodium- and chloride-ions in the solution
- after the hydrochloric acid is used up, the conductivity rises strongly because there are more and more hydroxide ions in the solution

**What can and should we do in the future:**

- Development of programs for teacher training.
- Development of teaching concepts.
- Answer the question:
  What should a future exam look like?
- Involving the use of digital media in teacher education.
- Exchange of experiences within the school, the country and internationally.



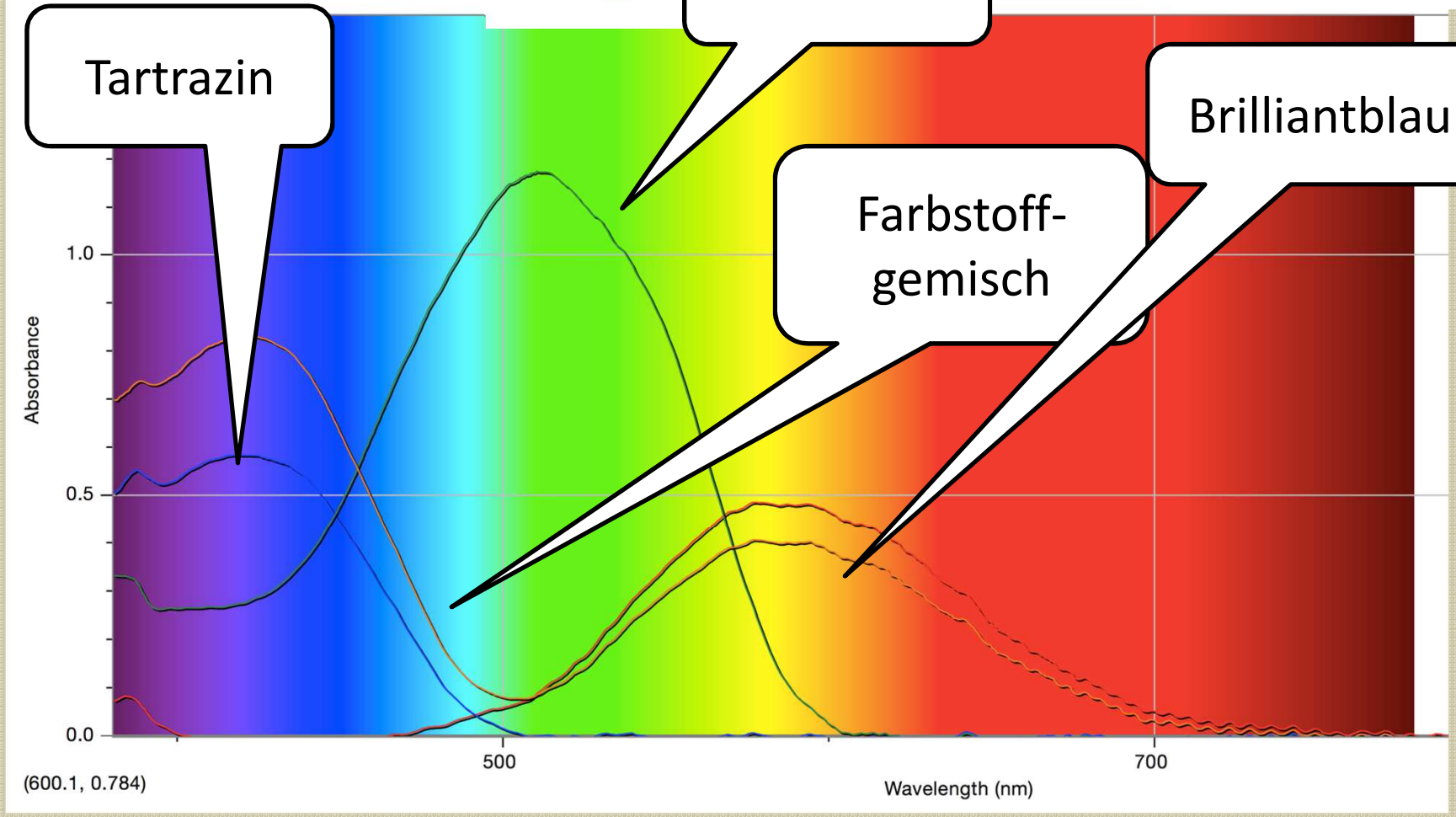
What can be done about an allergy to the dye Azorobin?

Tatrazin

Azorobin

Brilliantblau

# Chemieunterricht 4.0



# Thank you for your attention.