

# ITiCSE 2011

16<sup>th</sup> Annual Conference on Innovation and Technology in Computer Science Education



TECHNISCHE  
UNIVERSITÄT  
DARMSTADT



Darmstadt, Germany, June 27-29, 2011

# RWTH AACHEN UNIVERSITY



## Measures to promote Interest in Computer Science

Prof. Dr. Ulrik Schroeder

# Invitation: SAIL-M project



Set Sails! - Schnitt mit einer Mengendifferenz

Datei Bearbeiten Beweis Hilfe

Zeigen Sie:  
 $(A \setminus B) \cap C = (A \cap C) \setminus B$

	Term	Regel
1	$(A \setminus B) \cap C$	Mengendifferenz
2	$= (A \cap B^C) \cap C$	Assoziativgesetz
3	$= A \cap (B^C \cap C)$	Kommutativgesetz
4	$= (B^C \cap C) \cap A$ $= A \cap (C \cap B^C)$ $= (A \cap B^C) \cap C$	

Assoziativgesetz  
 $(A \cap B) \cap C = A \cap (B \cap C)$   
 $(A \cup B) \cup C = A \cup (B \cup C)$

De Morgan'sche Gesetze  
 $(A \cap B)^C = A^C \cup B^C$   
 $(A \cup B)^C = A^C \cap B^C$

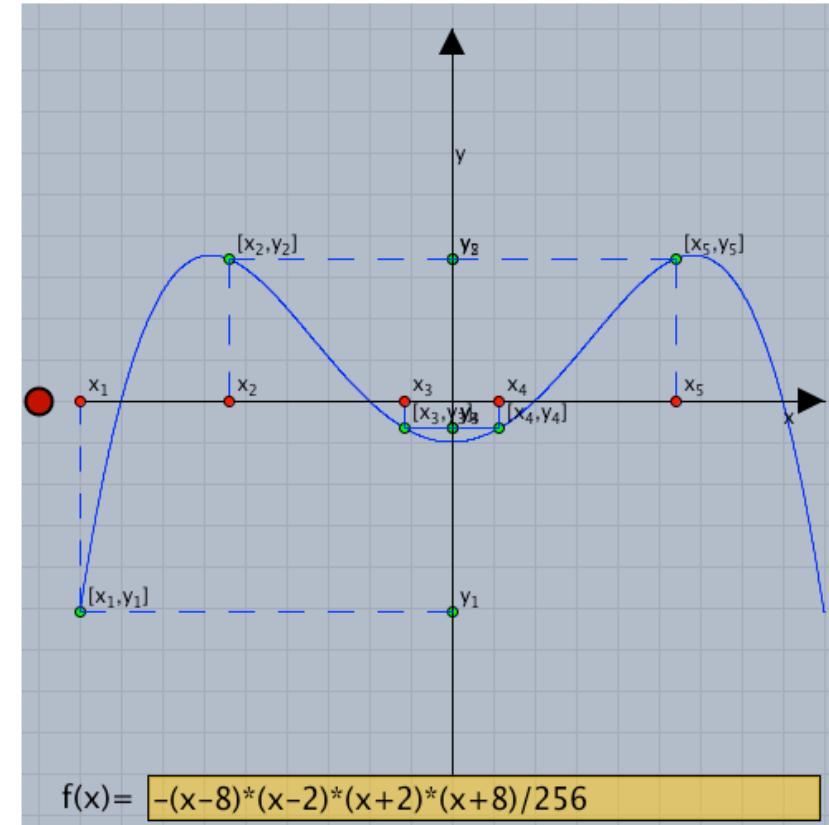
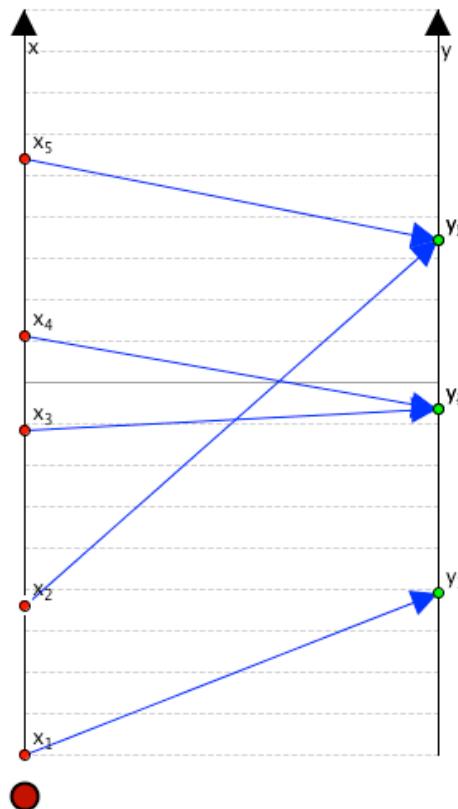
3	$\leftarrow$	4	$\rightarrow$
5			
6	$= A \cap (C \cap B^C)$	Assoziativgesetz	
7	$= (A \cap C) \cap B^C$	Mengendifferenz	
8	$= (A \cap C) \setminus B$		

# Invitation: Squiggle-M



Funktionsgraphen und Zuordnungsdiagramme

Schau dir Funktionsgraphen und ihre Zuordnungsdiagramme an!



$$f(x) = -(x-8)*(x-2)*(x+2)*(x+8)/256$$

Graph vs. Zuordnung



© 2009-2010, Maren Hiob-Viertler, PH Weingarten  
& Andreas Fest, PH Schwäbisch Gmünd  
[Impressum & Nutzungsbedingungen](#)



Kongruenzabbildungen

Die gelbe Figur wird auf die blaue abgebildet.  
Verändere die Lage der gelben Figur. Beobachte.

Aktuelle Abbildung:  
**Schubspiegelung in Richtung s**

Wähle: Schubspiegelung

Diese Konfiguration verändern.

Abbildung beobachten

# L<sup>2</sup>P university learning tools



Hello, Ulrik Schroeder | Abmelden | Suche | Impressum | Hilfe



L<sup>2</sup>P > Meine Veranstaltungen > Lernraum 11ss-02735 > Informationen

Meine Veranstaltungen

Lernraum  
11ss-02735

Öffentlicher Bereich

Informationen

Ankündigungen  
E-Mails  
Umfragen  
Hyperlinks

Lernmaterialien

Literatur

Gemeinsamer Bereich

Betreuer-Bereich

Teilnehmer

Einstellungen



Frühere Semester

Aktuelles

RWTH AACHEN  
UNIVERSITY

## Ankündigungen

**Exam on Thursday, July 14th** 24.06.2011 17:35  
von Hendrik Thüs

The exam for the lecture "eLearning" will be oral, questions will be related to the projects. All the presentations (including the ones by the invited speakers) will be subject of the exam. Every exam will be 15-20 minutes per person and...

**Grades - Assignment 5** 09.06.2011 13:58  
von Hendrik Thüs

The grades of assignment 5 are now available (see attachment).

**Assignment 6** 09.06.2011 09:24  
von Hendrik Thüs

Assignment 6 is now available and can be downloaded in the "learning materials" section.

**Presentation on Wednesday, June 8th** 07.06.2011 15:53  
von Hendrik Thüs

The presentation of the first results of the projects will take place on **Wednesday, June 8th, 14:00 - 15:30 in room 5054**.

Please be there on time. Each group will have 10 minutes to present the work, followed by 2-3 minutes of questions.

Timetable:

...

**Grades - Assignment 4** 19.05.2011 13:50  
von Hendrik Thüs

The grades of assignment 4 are now available (see attachment).

## Umfragen

Status	Name↑	Anonym	Geändert von	Geändert
● ●	Einstiegsumfrage	■		28.02.2011 10:11

Alle Umfragen anzeigen  Umfrage erstellen

## Hyperlinks

- 📁 eLearning - Beispiele
- 📁 1. Einstieg
- 📁 2. Lerntheorien
- 📁 3. Didaktik
- 📁 4. Multimedialernen
- 📁 B. Konzeption
- 📁 Prototyping
- 📁 C Drehbuch
- 📁 D. Produktion
- 📁 5. eLearning-Werkzeuge
- 📁 6. Assessment
- 📁 Anleitungen zu Moodle
- 📄 e-teaching.org - Portal mit zahlreichen Inforamtionen zu eLearning
- 📄 Entwicklung hypermedialer Lernsysteme - Blumstengel
- 📄 Beats Biblionetz
- 📄 CiL E-Assessment Informationen
- 📄 Moodle-Forumbeitrag: Tool zum Erstellen eines Lückentextes
- 📄 Ideengebung: Einsatzszenarien für eTests

Alle Hyperlinks anzeigen  Hyperlink hinzufügen

# L<sup>2</sup>P: Learning Analytics



Hallo, Ulrik Schroeder | Abmelden | Suche | Impressum | Hilfe

**Lernraum**  
11ss-02735

**Meine Veranstaltungen**

**eLearning (Vorlesung/Übung)**  
Universitätsprofessor Dr.-Ing. Ulrik Schroeder, Dr.rer.nat. Mohamed Amine Chatti, Dipl.-Inform. Hendrik Thüs, Dipl.-Inform. Daniel Herding, Dipl.-Inform. Philipp Brauner ...  
Lehr- und Forschungsgebiet Informatik 9 (Computerunterstütztes Lernen)

Aktualisieren

- Betreuer-Bereich
- Gemeinsamer Bereich
- Informationen
- Lernmaterialien
- Literatur
- Öffentlicher Bereich

- Manager
- Studierende
- Weitere Teilnehmer

Zur Anzeige der Seitenstatistik | Statistik als CSV exportieren

Tag	Manager	Studierende	Weitere Teilnehmer
26. Mai	15	61	0
27. Mai	75	16	0
28. Mai	0	0	0
29. Mai	0	41	0
30. Mai	0	72	0
1. Jun	84	107	0
2. Jun	0	42	0
3. Jun	56	51	0
4. Jun	0	14	0
5. Jun	0	0	0
6. Jun	26	32	0
7. Jun	29	204	0
8. Jun	83	192	0
9. Jun	0	238	0
10. Jun	0	24	0
11. Jun	0	16	0
12. Jun	0	25	0
13. Jun	0	39	0
14. Jun	0	24	0
15. Jun	0	12	0
16. Jun	0	0	0
17. Jun	0	150	0
18. Jun	0	51	0
19. Jun	0	0	0
20. Jun	0	13	0
21. Jun	0	56	0
22. Jun	0	100	0
23. Jun	22	0	0
24. Jun	14	0	0

# ITiCSE 2011 program



Time	Saturday	Sunday	Monday			Tuesday			Wednesday					
8:30 AM			Welcome & Opening Session											
8:45 AM			Keynote: Ulrik Schroeder, RWTH Aachen			Paper Session	Paper Session	Supporter Session	Keynote: Mark Guzdial Georgia Inst. of Technology					
9:00 AM	Working Groups		Free-Text Questions and Assessment			Introductory Programming			Tips & Techniques II: Computer Arch.					
9:15 AM									Tips & Techniques III: Tools & APIs					
9:30 AM									Tips & Techniques IV: Novice Progr.					
9:45 AM														
10:00 AM			Coffee Break & Posters			Coffee Break & Posters			Coffee Break & Posters					
10:15 AM														
10:30 AM														
10:45 AM			Paper Session	Paper Session	Panel Session	Paper Session	Paper Session	Tips & Techniques I: Ideas & Insights	Paper Session	Paper Session	Supporter Session			
11:00 AM			Coding Skills	Web Development	Outreach Programs to Promote CS & ICT		K-12 Approaches I	Visualization	Facilitating Programming Instruction					
11:15 AM									Broadening the Perspective					
11:30 AM														
11:45 AM			Lunch			Lunch			Lunch					
12:00 PM														
12:15 PM														
12:30 PM														
12:45 PM														
1:00 PM														
1:15 PM			Paper Session	Paper Session	Working Group Reports	Excursions			Paper Session	Paper Session	Paper Session			
1:30 PM			Understanding OO	Activities for Hardware Courses	K-12 Approaches II				Peer-Assisted Learning	Engaging Students				
1:45 PM														
2:00 PM			Break between Sessions						Break between Sessions					
2:15 PM			Paper Session	Paper Session	Paper Session				Paper Session	Paper Session	Paper Session			
2:30 PM														
2:45 PM			Attracting K-12 Students to CS			Enhancing CS Lectures			New Approaches in Undergraduate Instruction					
3:00 PM														
3:15 PM						Environments for Motivating Students			Automated Assessment					
3:30 PM									Attracting Girls and Women to CS					
3:45 PM			Break between Sessions											
4:00 PM			Coffee Break & Posters						Closing Session					
4:15 PM														
4:30 PM			Paper Session	Paper Session	Paper Session									
4:45 PM														
5:00 PM			Tool Support for Upper-Level Courses			Integrating Web based Technologies into Courses								
5:15 PM						Collaboration and Peer Instruction in CS 1								
5:30 PM														
5:45 PM														



## ► Engineering innovative learning systems

- ▶ Learning theories
- ▶ Web and mobile technologies
- ▶ Open assessment and intelligent feedback
- ▶ Educational data mining
- ▶ Learning analytics
- ▶ Recommendation for PLE

The screenshot shows the L2P portal interface. At the top, there's a navigation bar with links like 'Mein Foyer', 'Aktuelles', 'CLIX-Lösungsgruppen', 'CLIX-Betreuningscenter', 'Suche', 'Hilfe & Support', and the 'JiCiL' logo. Below the navigation is a search bar with placeholder text 'Sie sind im Foyer | Willkommen, CAMPUSticker! | RWTHAACHEN UNIVERSITY'. The main content area has two sections: 'Meine Veranstaltungen' and 'CAMPUS-Veranstaltungskalender'. 'Meine Veranstaltungen' lists courses for the winter semester (Semester: 2007/2008 Wintersemester), including 'Klassung Design-Projektseminar' (Type: S, Do 18:10, 3 participants), various Java programming groups (Gruppe 1-10, Type: Ü, Do 23:10, 0 participants), and a 'Web Engineering' course (Type: V, Mo 22:10, 37 participants). 'CAMPUS-Veranstaltungskalender' shows a weekly calendar from Monday to Friday, October 2007, with specific events like 'Projekttag für Alle Java-Abi' and 'Projekttag für Alle Java-Abi' listed.

## ► Computing education

- ▶ Teaching CS
- ▶ Educational technologies
- ▶ InfoSphere / „Schülerlabor Informatik“
- ▶ Gender and Diversity (G&D)



The complex block contains several images related to computing education. It includes a smartphone displaying a game, a tablet with a green screen, a white Android robot, and two young girls interacting with a blue table that has a robot on it. Below these images is the 'InfoSphere' logo with the tagline 'World of Informatics'.

# Outline

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- ▶ go4IT! -- Generate interest in Computer Science
- ▶ InfoSphere -- Out-of-school-learning
- ▶ CS teacher ed -- Multipliers
- ▶ It4M -- School -> University
- ▶ 4L -- Vision: bringing all together

# Attracting (female) students to CS



“It’s great that women have choices. That they’re not choosing CS is *our problem* — maybe it’s a marketing problem, maybe it’s an image problem, maybe it’s a cultural problem... I agree with Shanahan that it’s always good to ask “Why.” But if you’re sick, you’re less concerned with how you got it, and more concerned with finding a cure..”



Mark Gudzial:  
Computing Education Blog

# Research staff @ i9 &CiL



Nadine Bergner



Thiemo  
Leonhardt



Daniel Herding



Jan Holz



Dr. Mohamed  
Amine Chatti



Prof. Dr.  
Ulrik Schroeder



Dr. Philipp Rohde



Patrick  
Stalljohann



Mostafa Akbari

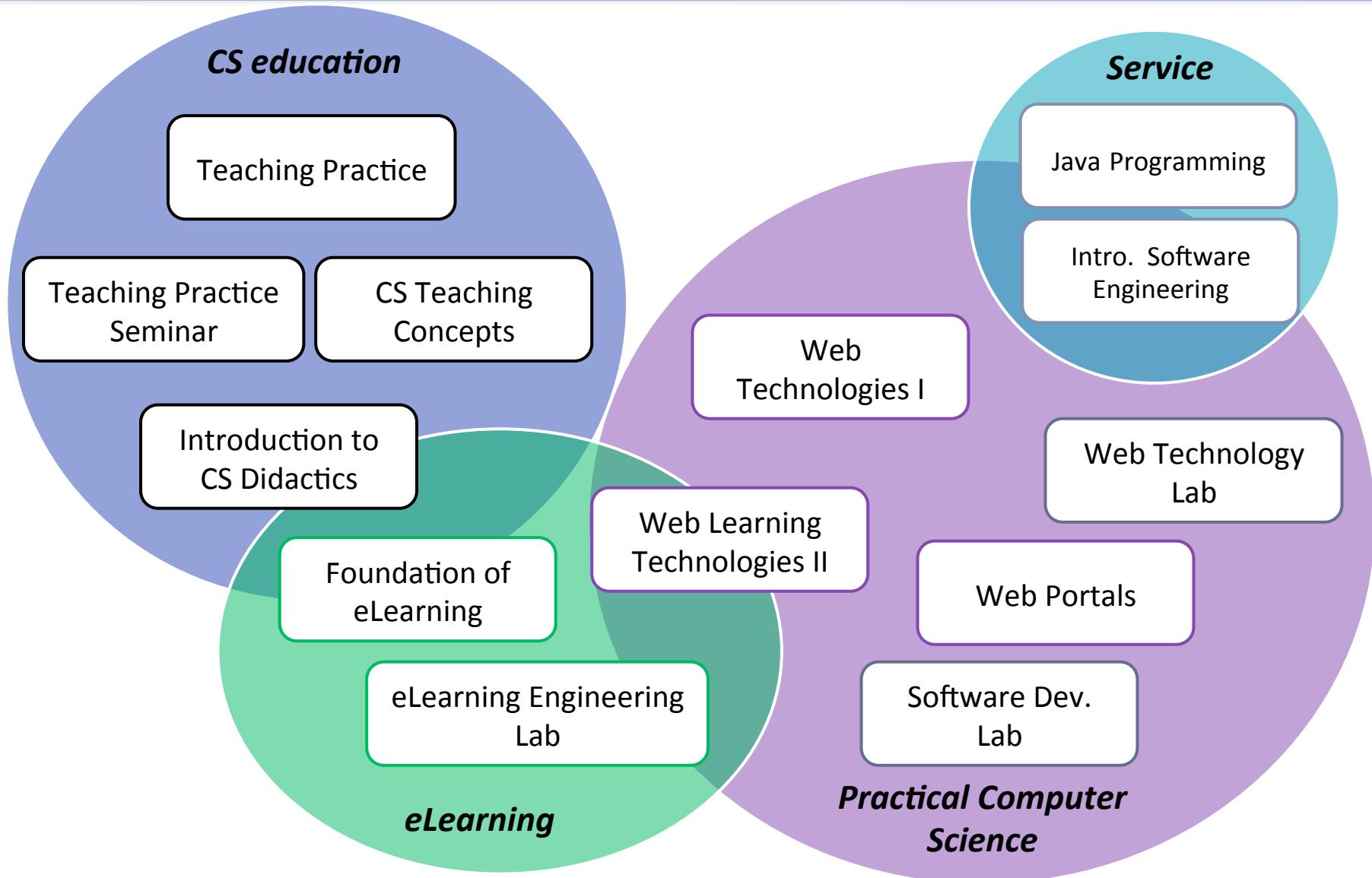


Hendrik Thüs

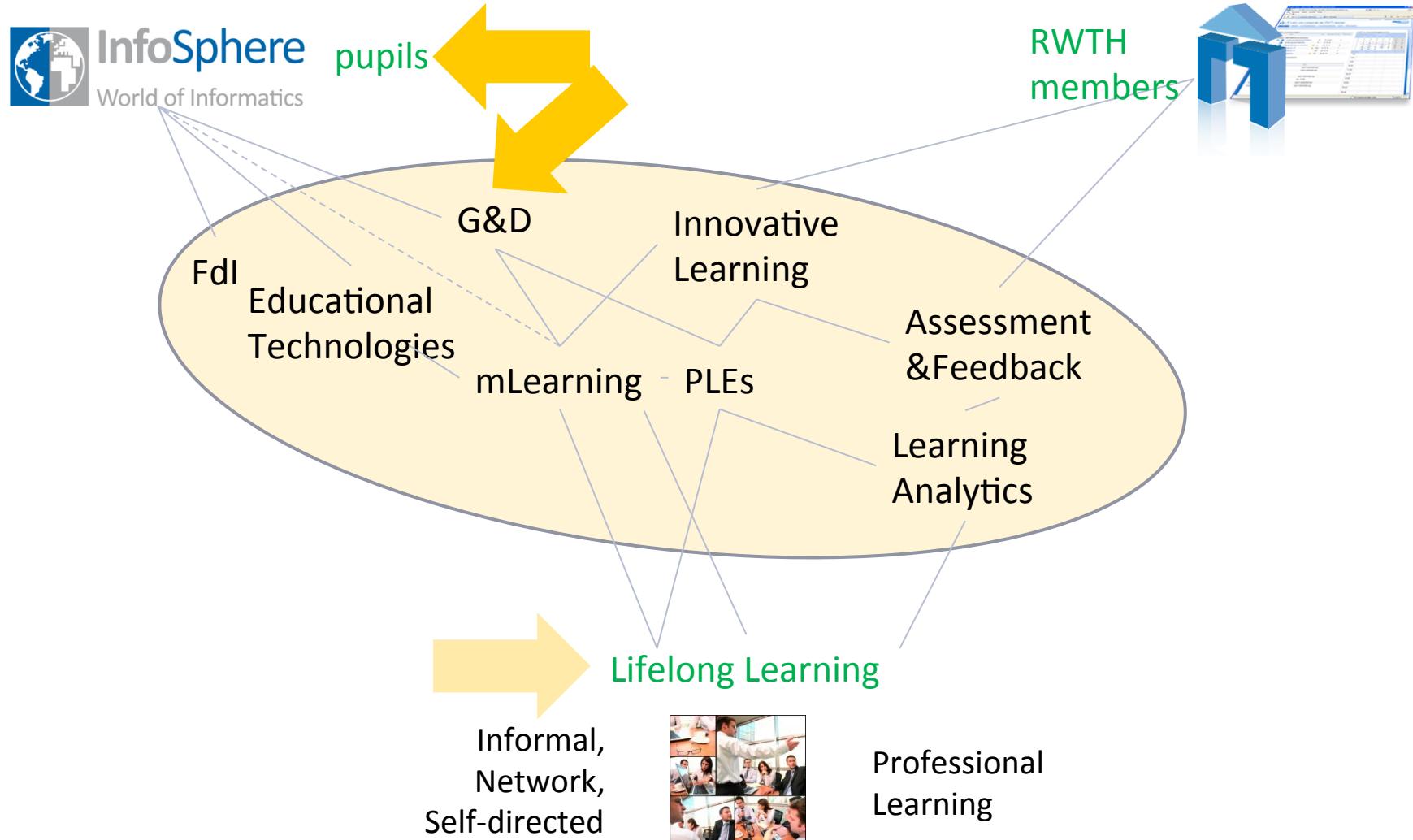


Anna Lea  
Dyckhoff

# Teaching



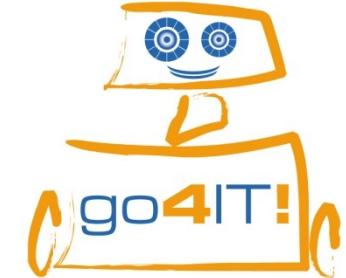
# Research Overview



# go4IT! – Interest in Technology & CS



- International tried & tested concept: robots
- Raising interest in computer science (STEM)
- Workshops in schools



**~1000** girls and **75** boys at the age of 10 to 14 participated since January 2009

1. Construction of a LEGO-robot
2. Develop programs for robots to solve tasks
3. Collaborative tasks on day 2
4. Presentation to parents, other students, ...



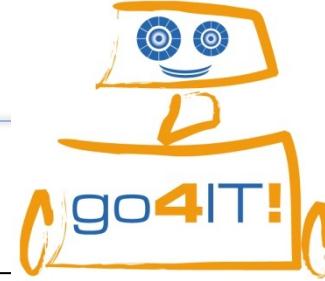
# go4IT! – Impressions



```
task main ()  
{  
    SetSensorTouch(IN_1);  
    OnRev(Motoren,Motorleistung);  
    until(Sensor Touch (IN_1) == 1);  
    Off(Motoren);  
    OnFwd(OUT_BC,50);  
    Wait(Zeit);  
}
```



# Study Design



▶ 100 workshops since January 2009

▶ n=680 students

▶ 85% girls

▶ 80% at the age of 11/12 years

(Technology/CS-) Self-Concept  
& Self-Efficacy



# go4IT! Study – observed variables



- ▶ Technical expertise (self-assessment)

8 items,  $\alpha=.703$

*“I was already engaged in construction kits”*

- ▶ Self-concept: Talent in computer science / STEM

4 Items,  $\alpha=.681$

*“I am not gifted in STEM”*

- ▶ Self-efficacy

4 Items,  $\alpha=.667$

*“I could become a computer science expert, if I want”*

- ▶ Perspective (interest in technology)

8 Items,  $\alpha=.751$

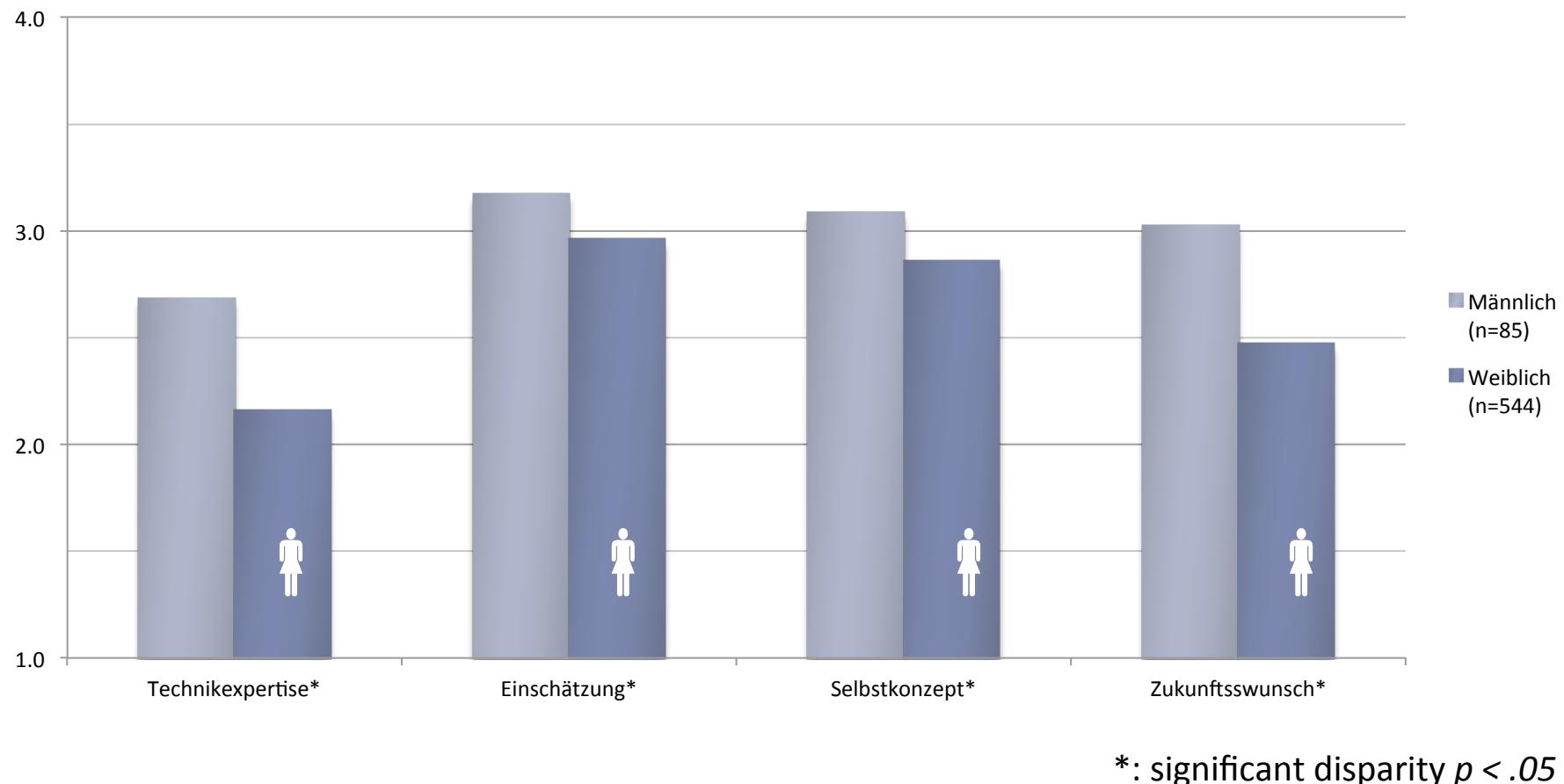
*“I’d like more technical and computer science lessons in school”*

# go4IT! – Initial situation



- ▶ Significant gender effects on each scale ( $p < .05$ )

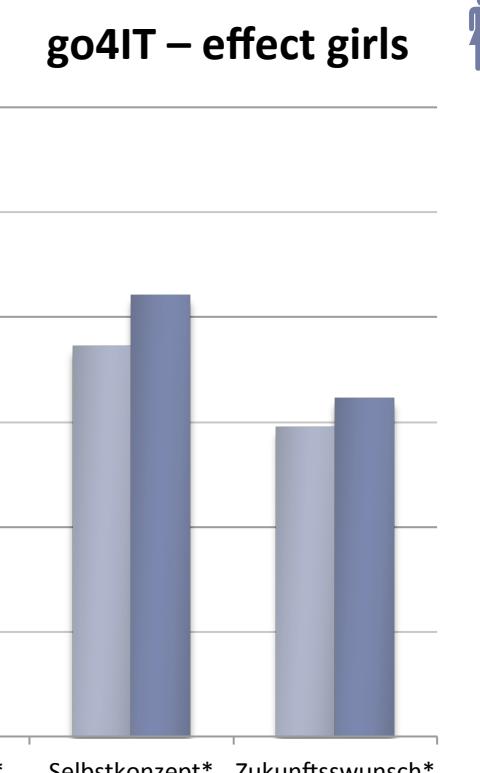
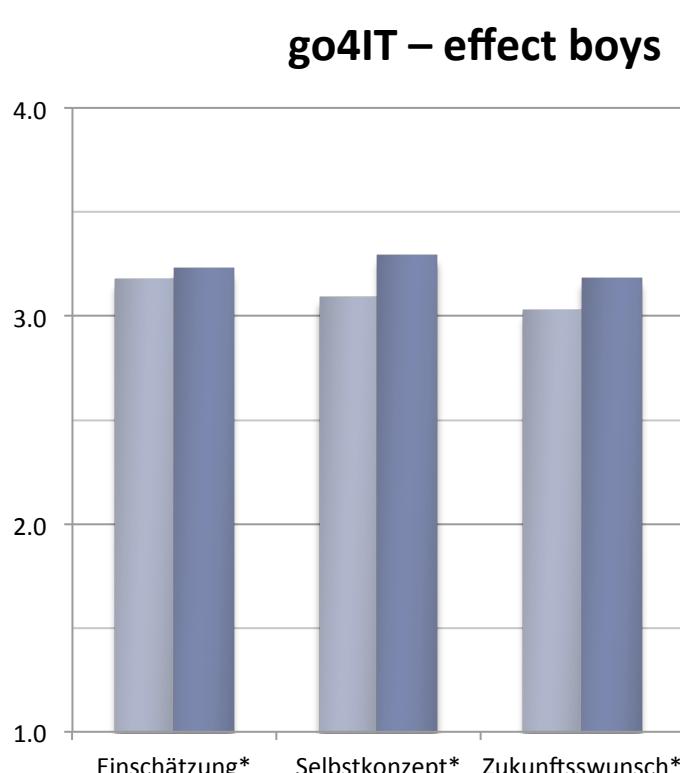
go4IT! – gender coefficient



# go4IT! – Workshop effect



- ▶ Significant effects on each of the scales (boys and girls)
- ▶ Further analysis:
  - ▶ How sustainable are workshop effects?
  - ▶ Which students are more affected?



\*: significant disparity  $p < .05$

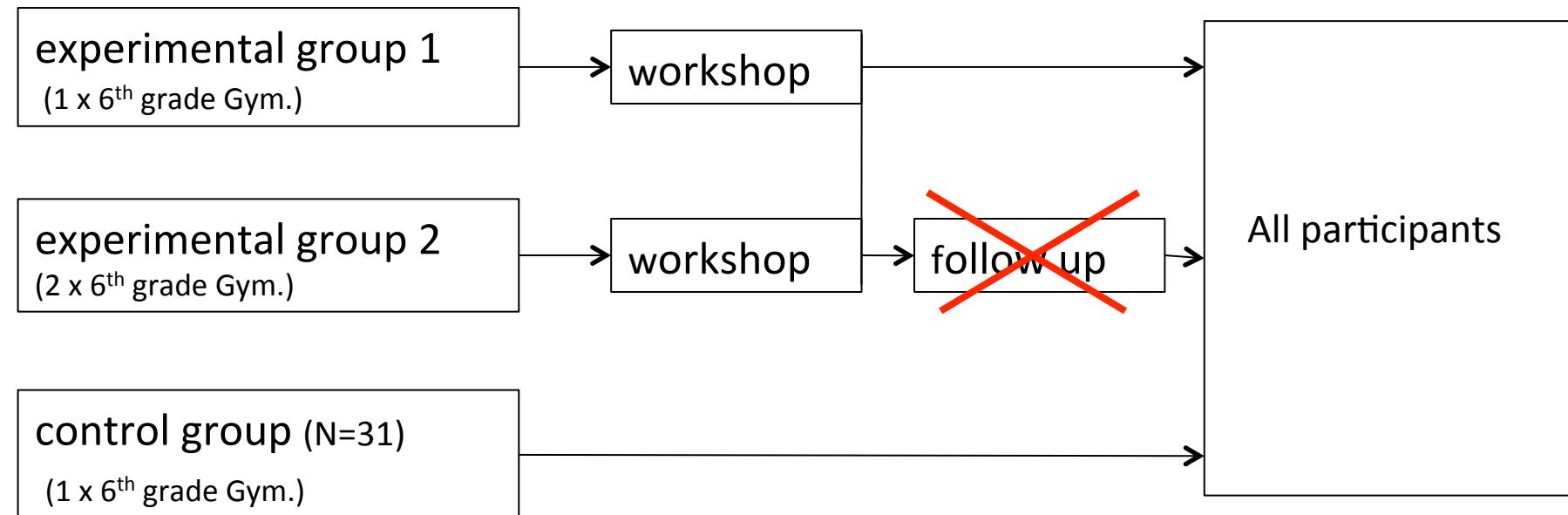
# Study design – Prof. Birgit Ziegler



Pretest (02/ 2010)

Inside test 03/2010

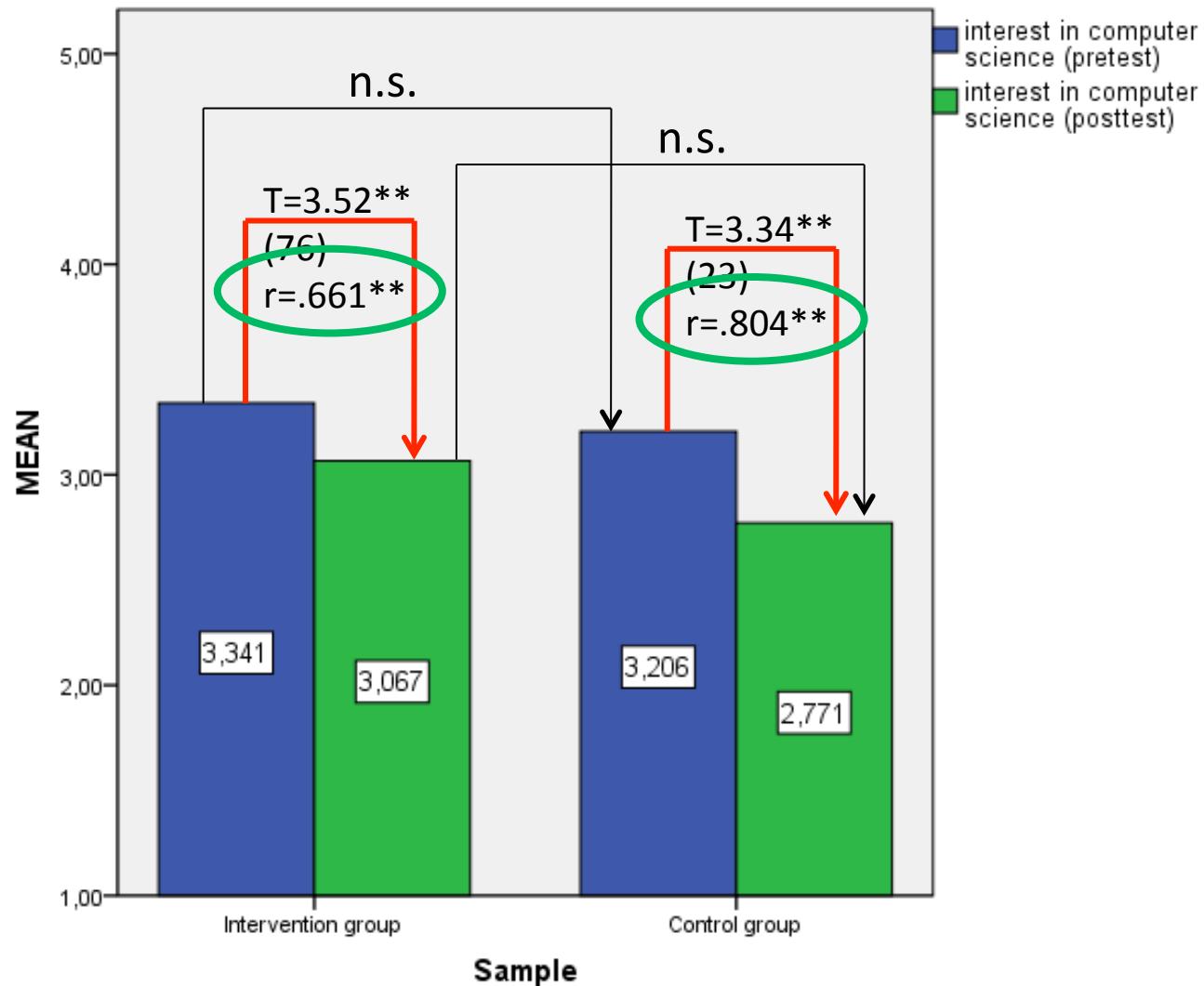
Posttest (06/2010)



## Sample

- ▶ N = 112 , ♀ 46% (Exp : control gr.: 43 : 52 ⇒ n.s.)
- ▶ 90% first language german
- ▶ age : Xq = 11,6 (s= 0,55)

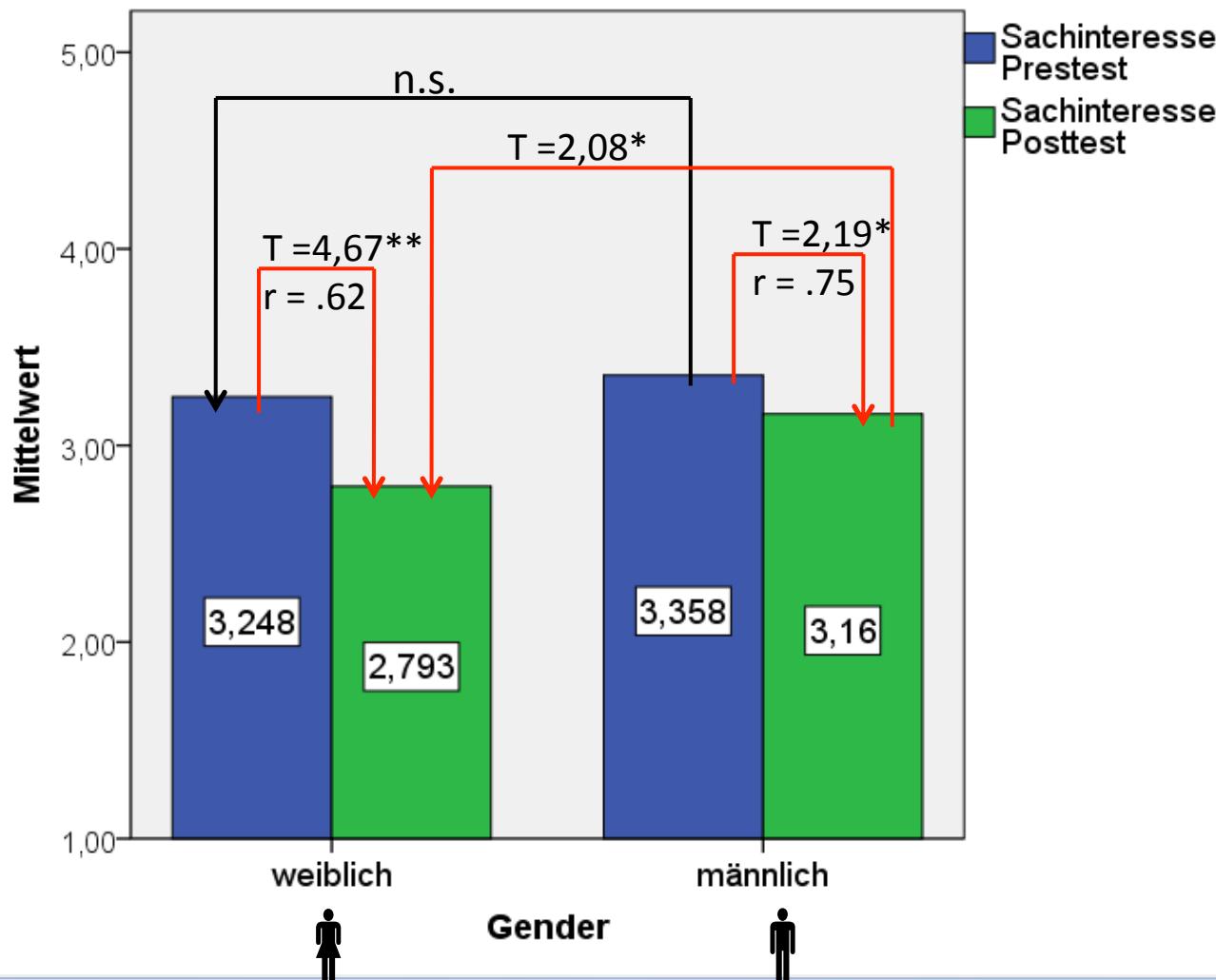
# Development of subjective interest



# Differential Analysis ⇔ Gender



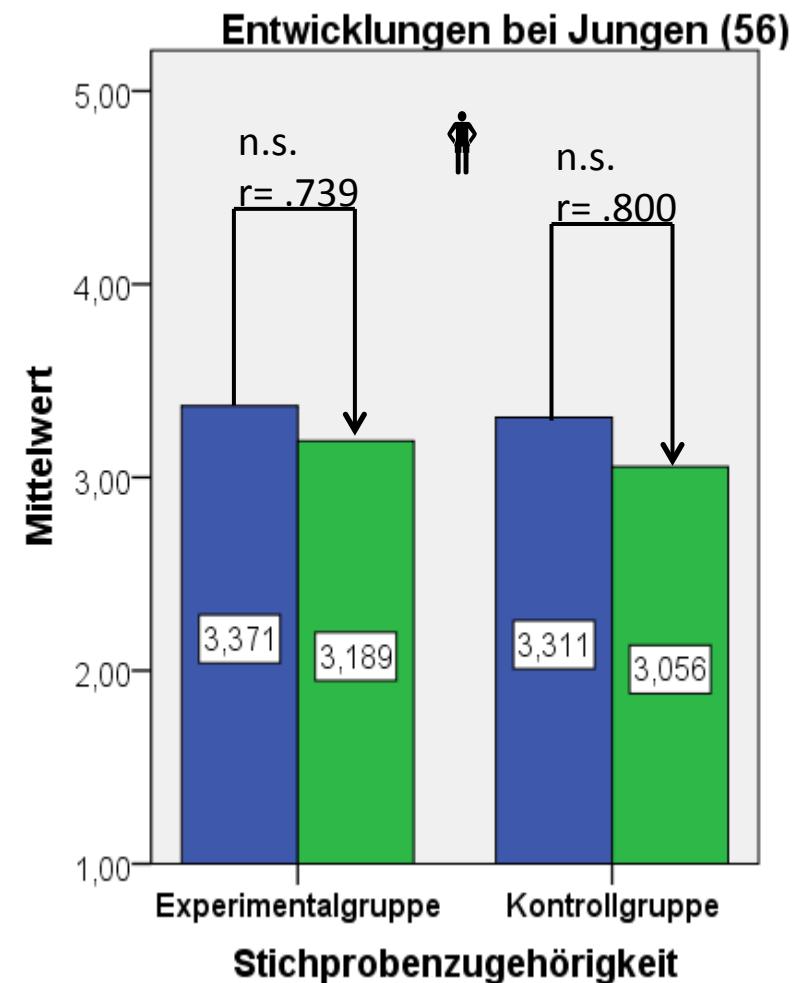
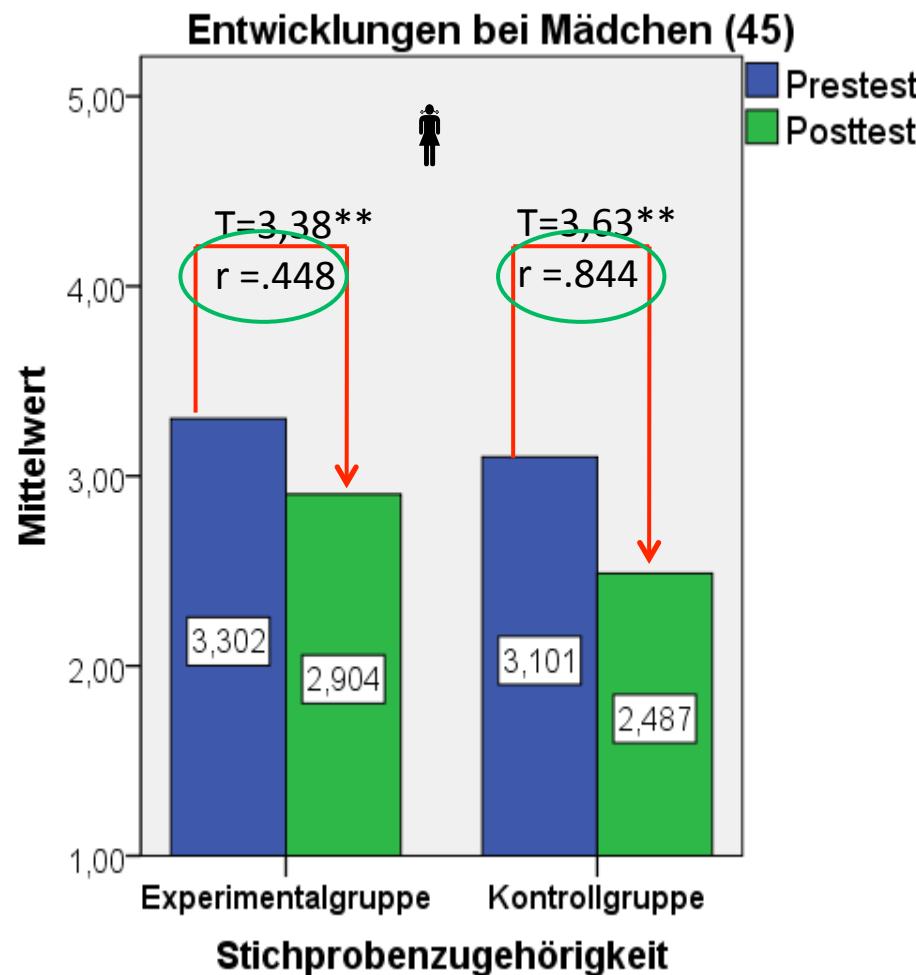
Difference in subjective interest: boys (59/56) and girls (51/45)



# Differential Analysis ⇔ Gender



## Gender-specific development of subject interest





Foster sustainable interest in STEM

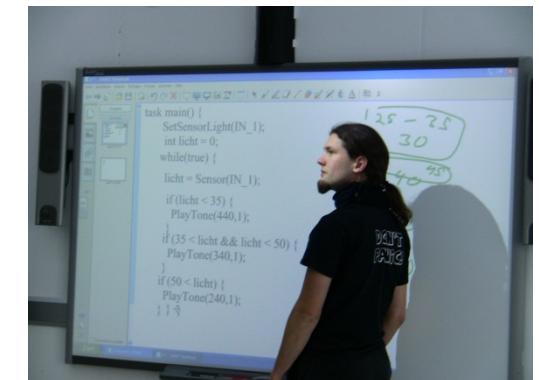
## GO4IT! – FOLLOW-UP WORKSHOPS

# Pedagogical concept

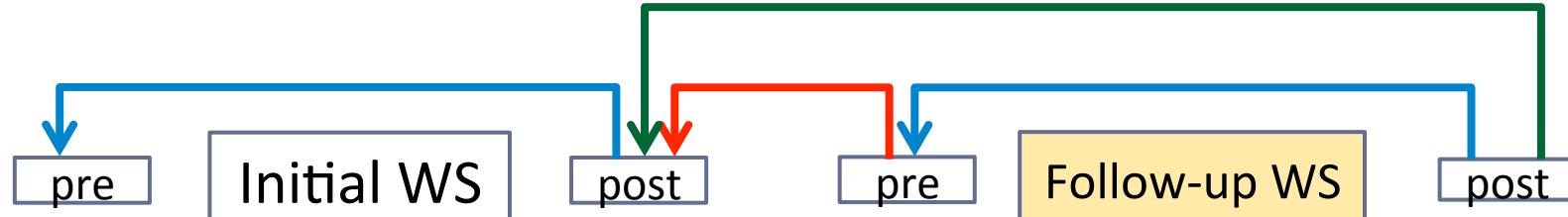


- ▶ Follow-up to initial go4IT!-Workshop
  - ▶ Interdisciplinary & CS relevance in daily life
  - ▶ Science Camp for two and a half days
- ▶ Consequences
  - ▶ Integration of „arts, crafting, music and programming“
  - ▶ Smartphones as new tangible artifact

# Impressions

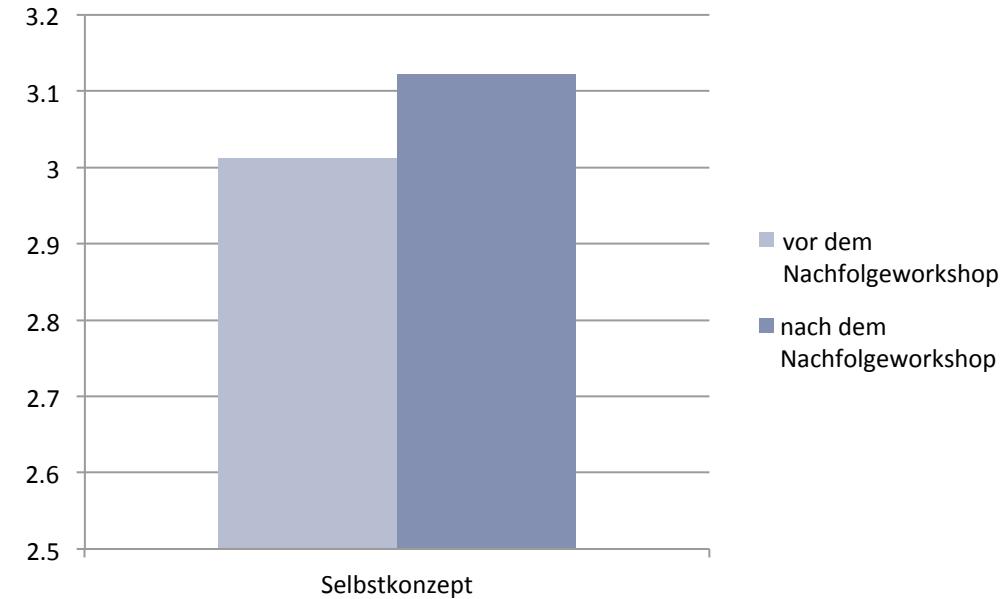
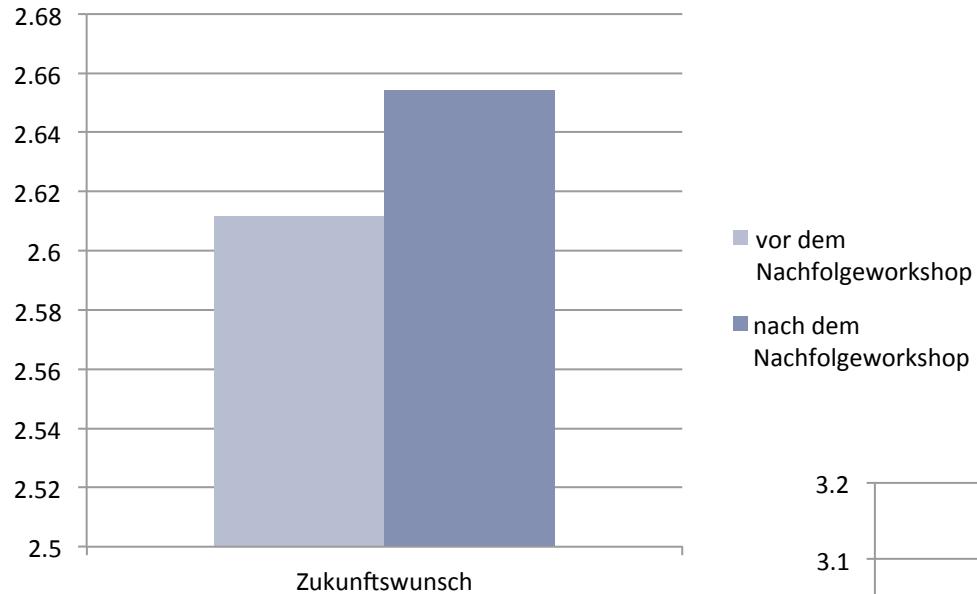


# Study Design

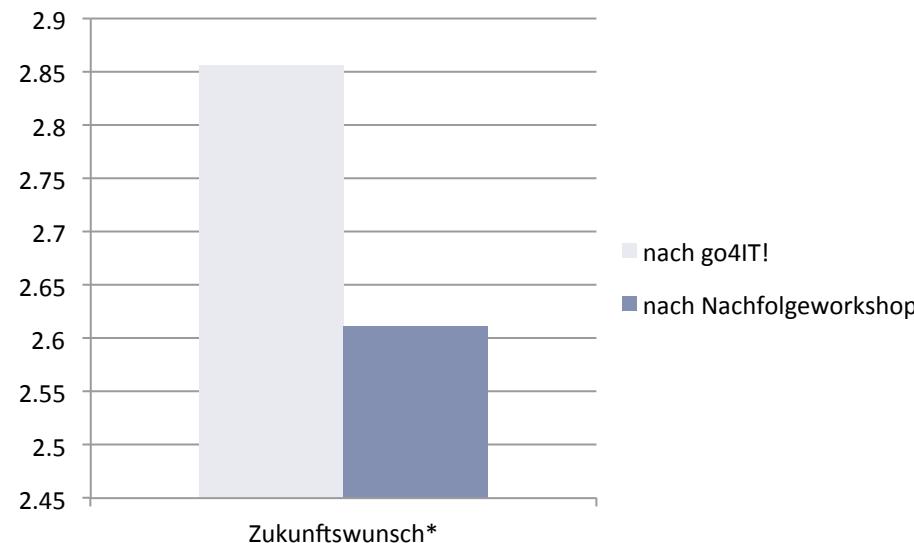
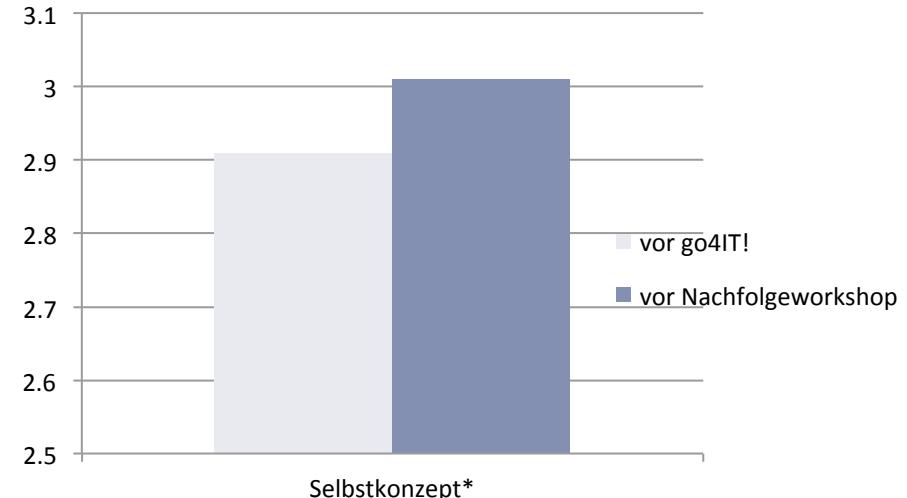
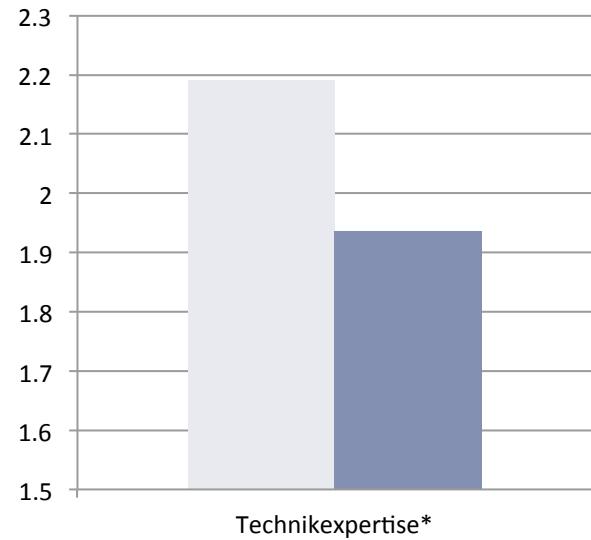


- ▶ Hypothesis:
  - ▶ Follow-up increases effects in measured variables
- ▶ Sample
  - ▶ n=48 girls
    - ▶ age of 12-13 years
    - ▶ 6 months since the first WS

# Preliminary Results



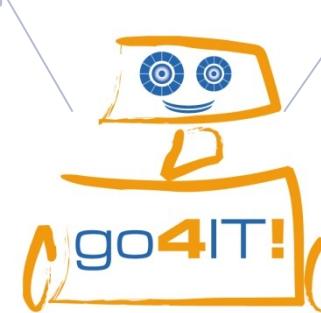
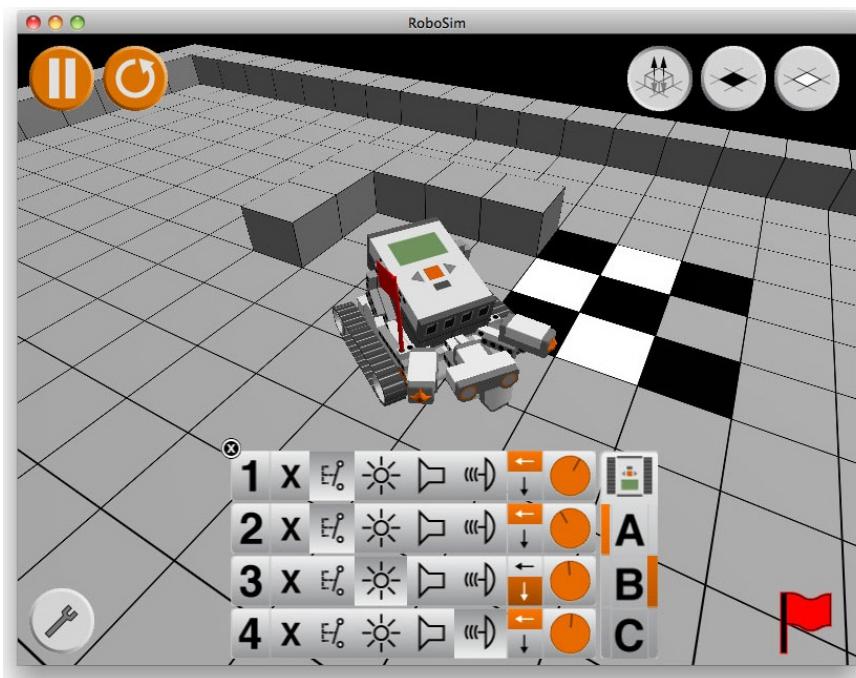
# Preliminary Results



# go4IT!-Simulator



- ▶ Integrated in go4IT!-IDE (reduced BrixCC)
  - ▶ Same Lego Bytecode as robots (tested with real workshop codes ...)
- ▶ Flexible positioning of various sensors, walls, cell colors on the fly
- ▶ Multi-robot mode
- ▶ Technical and users test, but no evaluations of real utilization



<http://schuelerlabor.informatik.rwth-aachen.de/simulator>



# InfoSphere

World of Informatics



**RWTHAACHEN  
UNIVERSITY**



**InfoSphere – Students Lab for Computer  
Science at RWTH Aachen University**

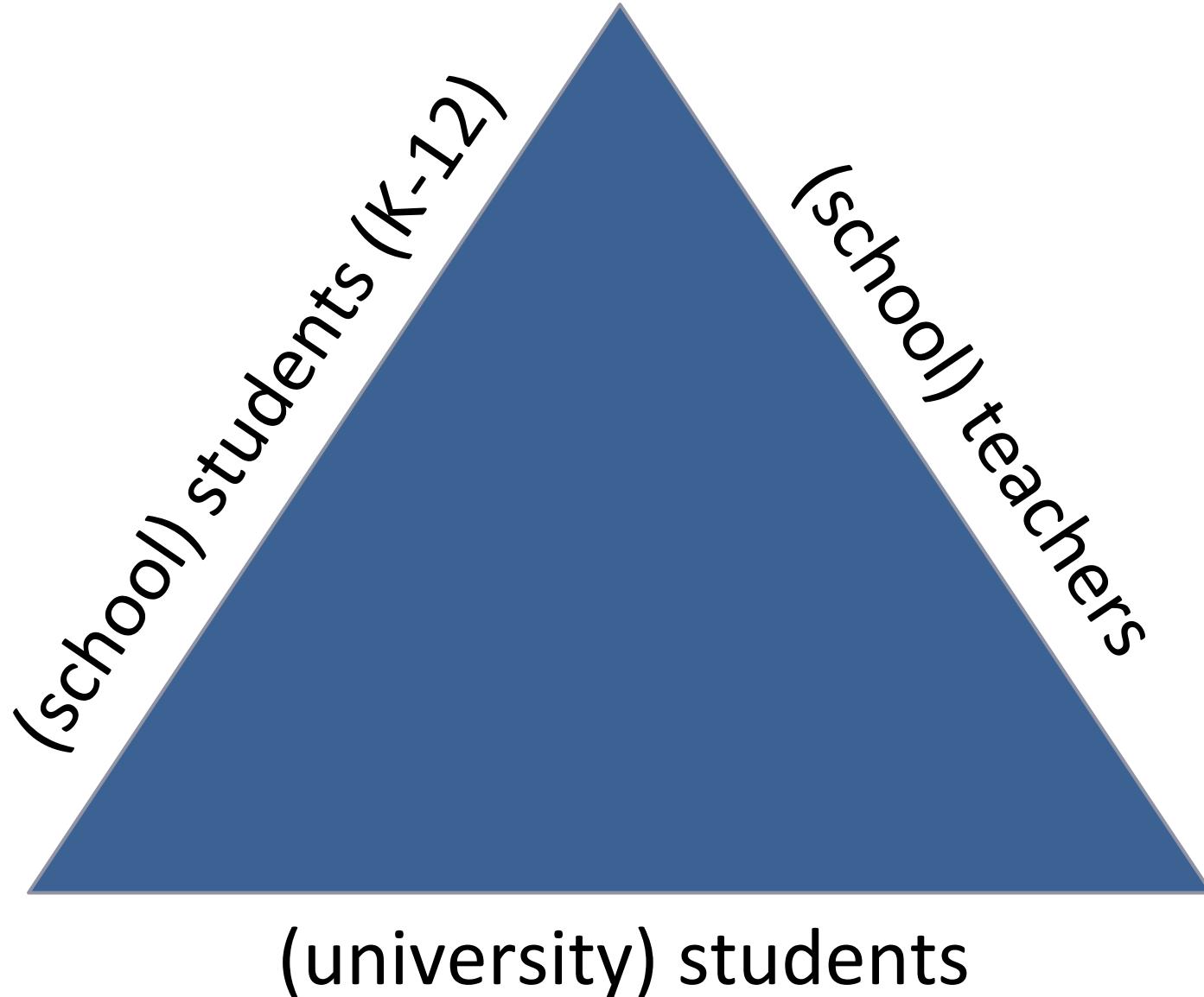
**Extracurricular out-of-school Learning Environment**

# Organization

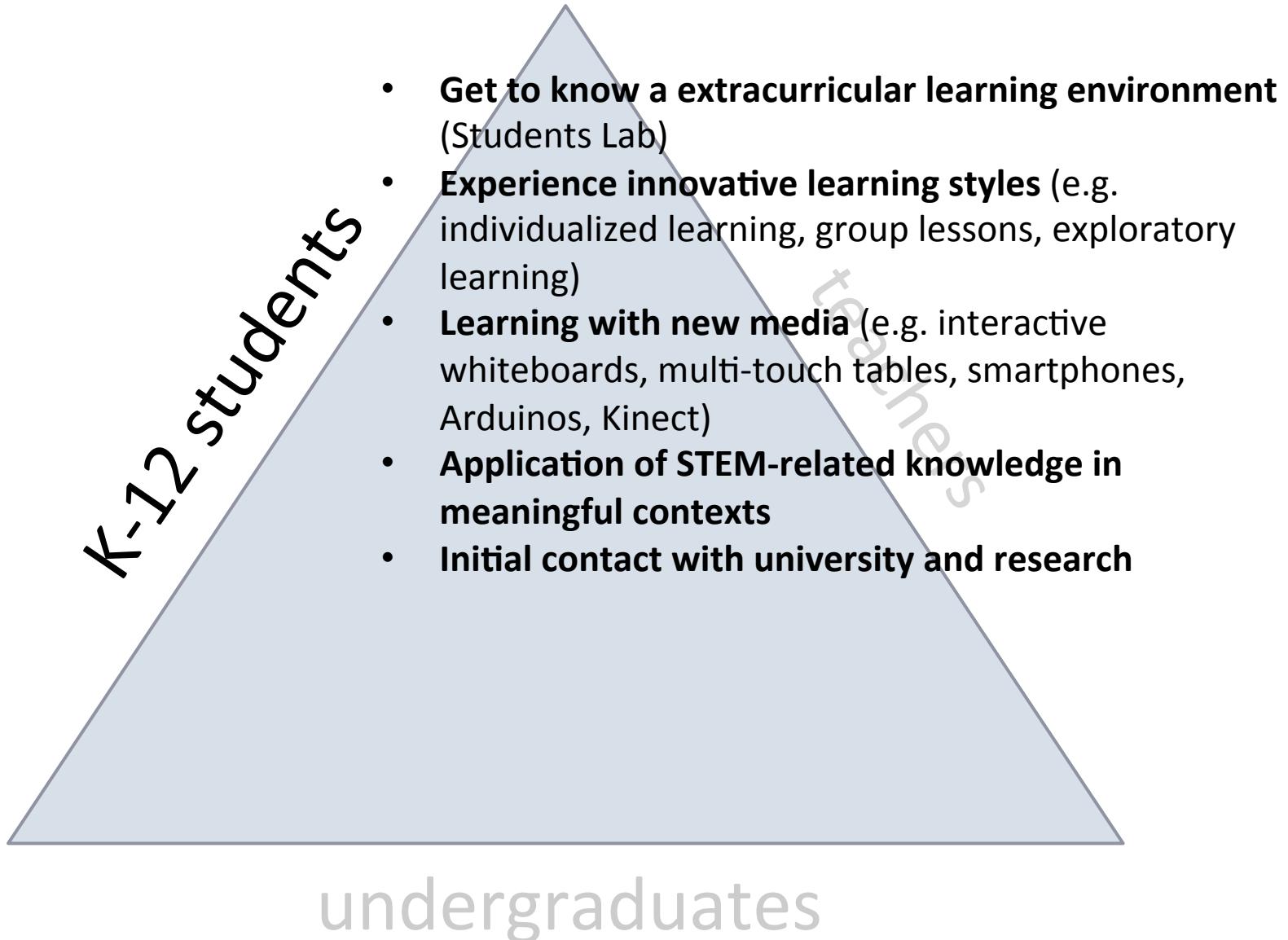


- ▶ Facilities: factory hall, flexible furniture
  - ▶ Shared by RoboScope
  - ▶ Installation sponsored by zdi-initiative NRW
- ▶ School classes with teacher (supervision)
  - ▶ Tutors: CSE undergraduates
  - ▶ Embedded in curriculum
- ▶ Additional events planned
  - ▶ Individual registration
  - ▶ Specific events
  - ▶ InfoCamp





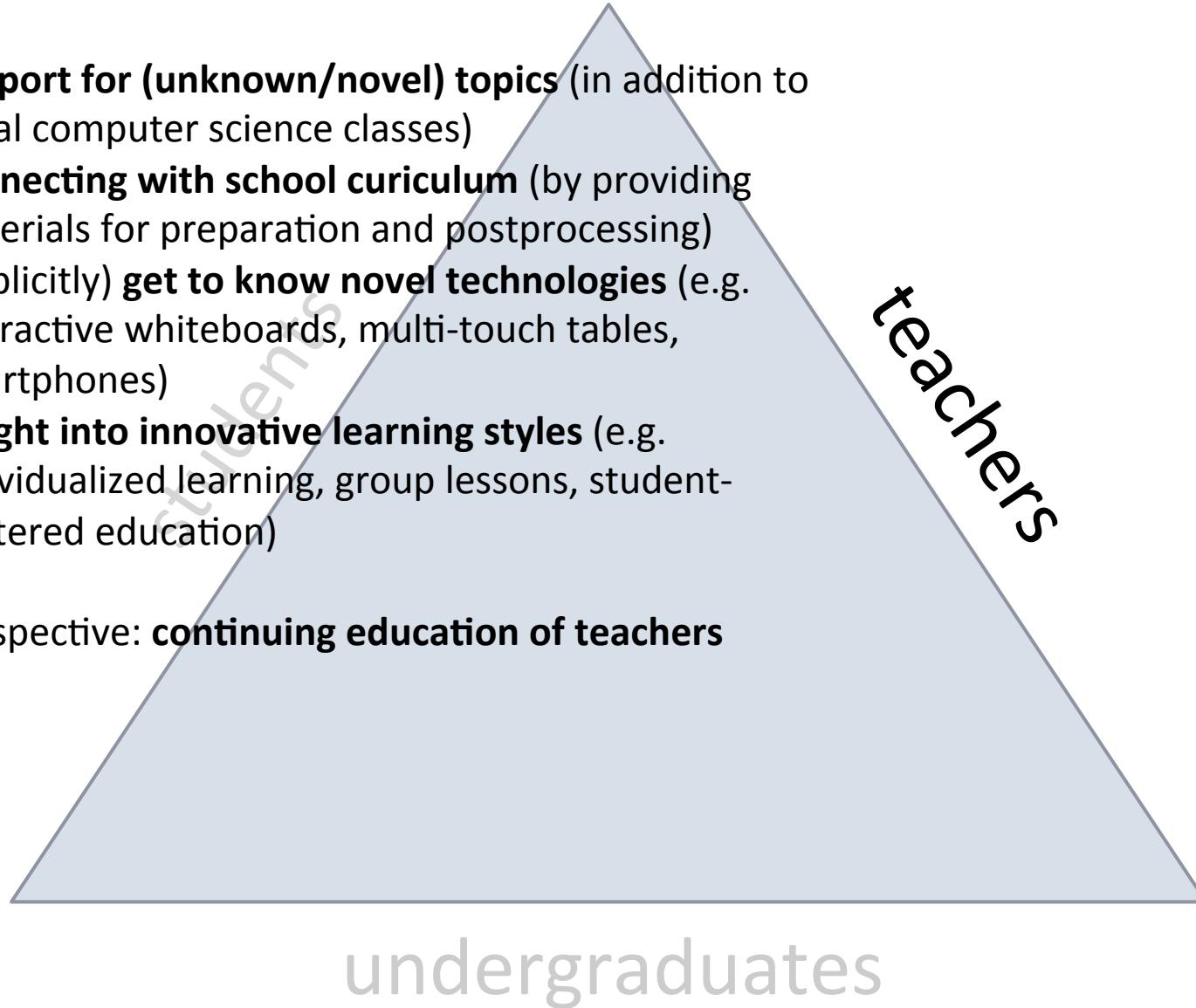
# Concept

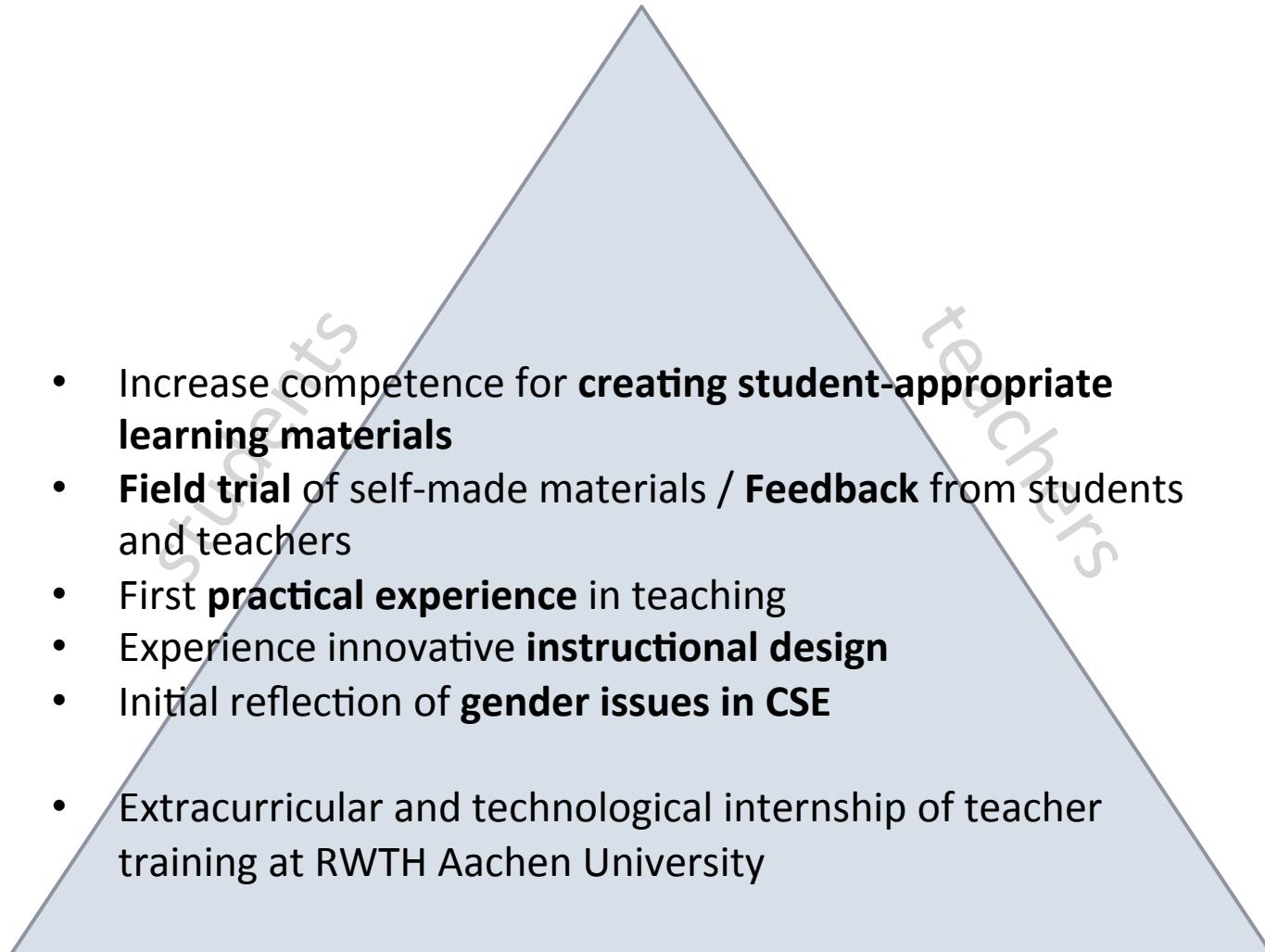


# Concept



- **Support for (unknown/novel) topics** (in addition to usual computer science classes)
- **Connecting with school curriculum** (by providing materials for preparation and postprocessing)
- (Implicitly) **get to know novel technologies** (e.g. interactive whiteboards, multi-touch tables, smartphones)
- **Insight into innovative learning styles** (e.g. individualized learning, group lessons, student-centered education)
- Prospective: **continuing education of teachers**





teacher students

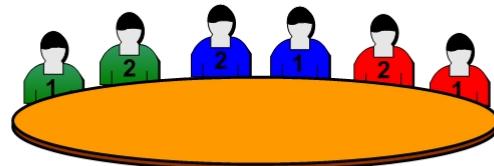
# Sequence of a Module



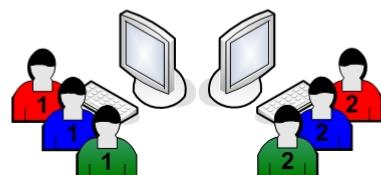
**T**eamarbeitsphase



**G**ruppenarbeitsphase



**Klein**gruppenarbeitsphase



- ▶ Methodological central theme:
  - ▶ Free and independent working of students
  - ▶ Working in groups of two (one laptop)
  - ▶ Working in small groups (3-5 students)
    - ▶ Based on equal tasks
    - ▶ Based on division of tasks (e.g. jigsaw teaching technique)
  - ▶ Partially supported by eLearning courses
    - ▶ Chronology and materials provided
  - ▶ Concluding retention of knowledge
    - ▶ Presentation
    - ▶ Discussion
    - ▶ Challenges / competition

# InfoSphere-Modules



Scratch & Alice



Shortest Path



Lego Turing machine



EAN-Codes



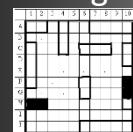
A Journey to the Center of the PC



Magic School of Informatics



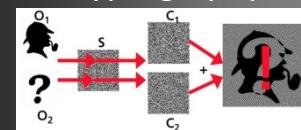
Android Programming



Artificial Intelligence



Visual Cryptography





## ► Magic School of Informatics

### ► Method:

- Children build their own magic wands and develop them on their magic license from **novice mage** to **arch mage**



### ► Content about Informatics:

- Binary numbers
- Image coding and transmission
- Error detection



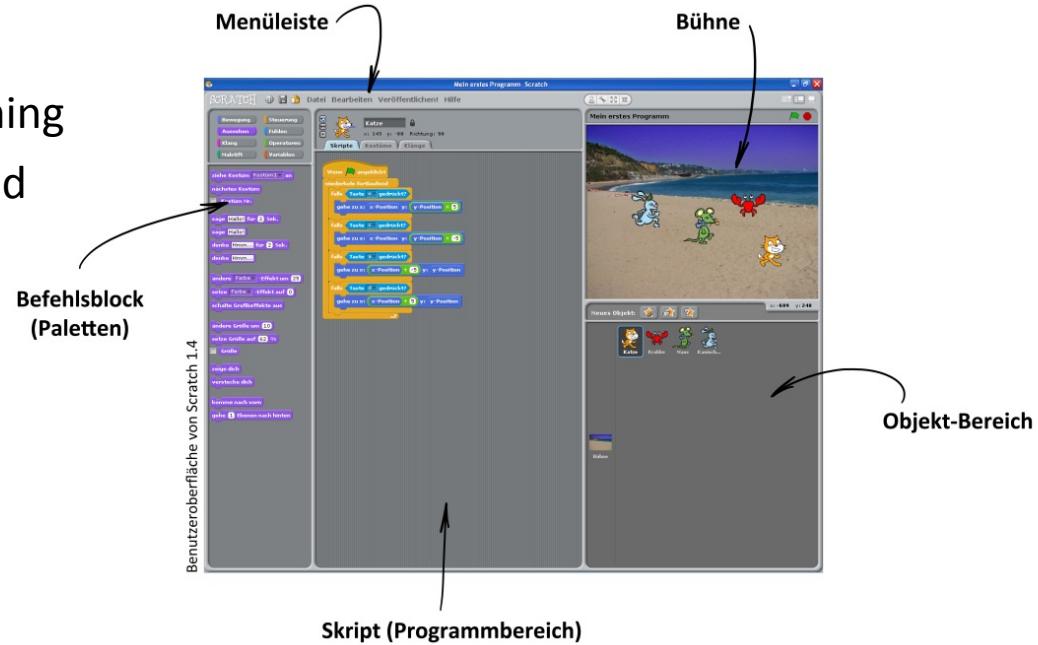
# Middle School (5<sup>th</sup> /6<sup>th</sup> )



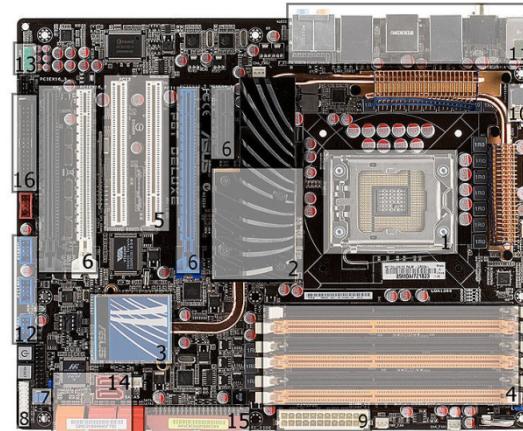
## ▶ Learning programming in a playful way with SCRATCH

### ▶ Content about Informatics:

- ▶ Introduction to (visual) programming
- ▶ Constructs like loops, variables and request



- ▶ Method: Jigsaw teaching technique
  - ▶ Students acquire knowledge on a certain topic in “teams of experts” and assemble their knowledge in mixed “working groups”.



## ► A Journey to the Center of the PC

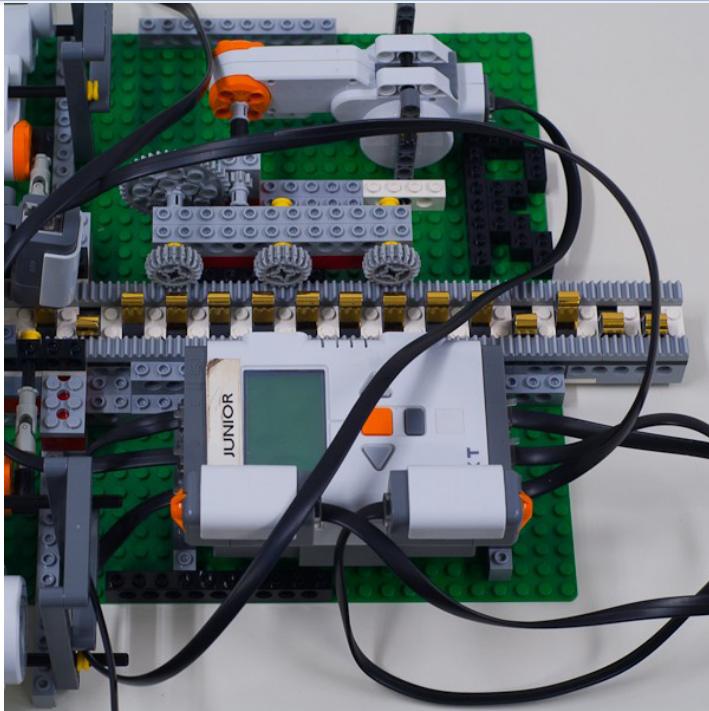
### ► Content :

- ▶ Get to know the hardware components of a PC
- ▶ Internet research about the different components (→ media literacy)

### ► Method: Group work

- ▶ Independently disassembling a PC
- ▶ Preparing a presentation (otos, slides, videos, ...)

# Modules for Senior High (11<sup>th</sup> / 12<sup>th</sup> )



## ▶ LEGO-Turing machine

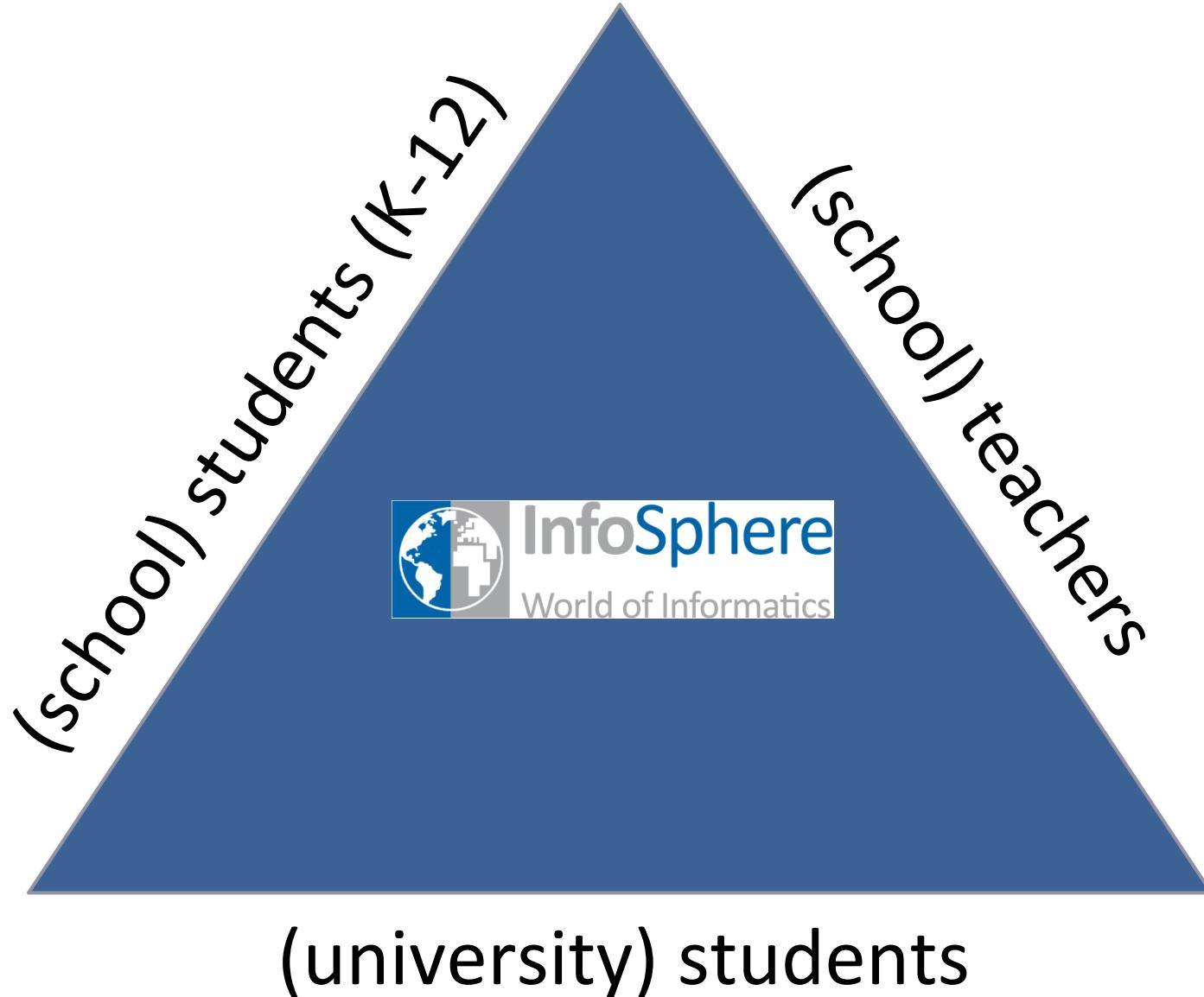
- ▶ Content about Informatics:
  - ▶ Theoretical model of a Turing machine
  - ▶ Terminology & functionality of a Turing machine
  - ▶ Tabular representation of exemplary transition functions

## ▶ Method:

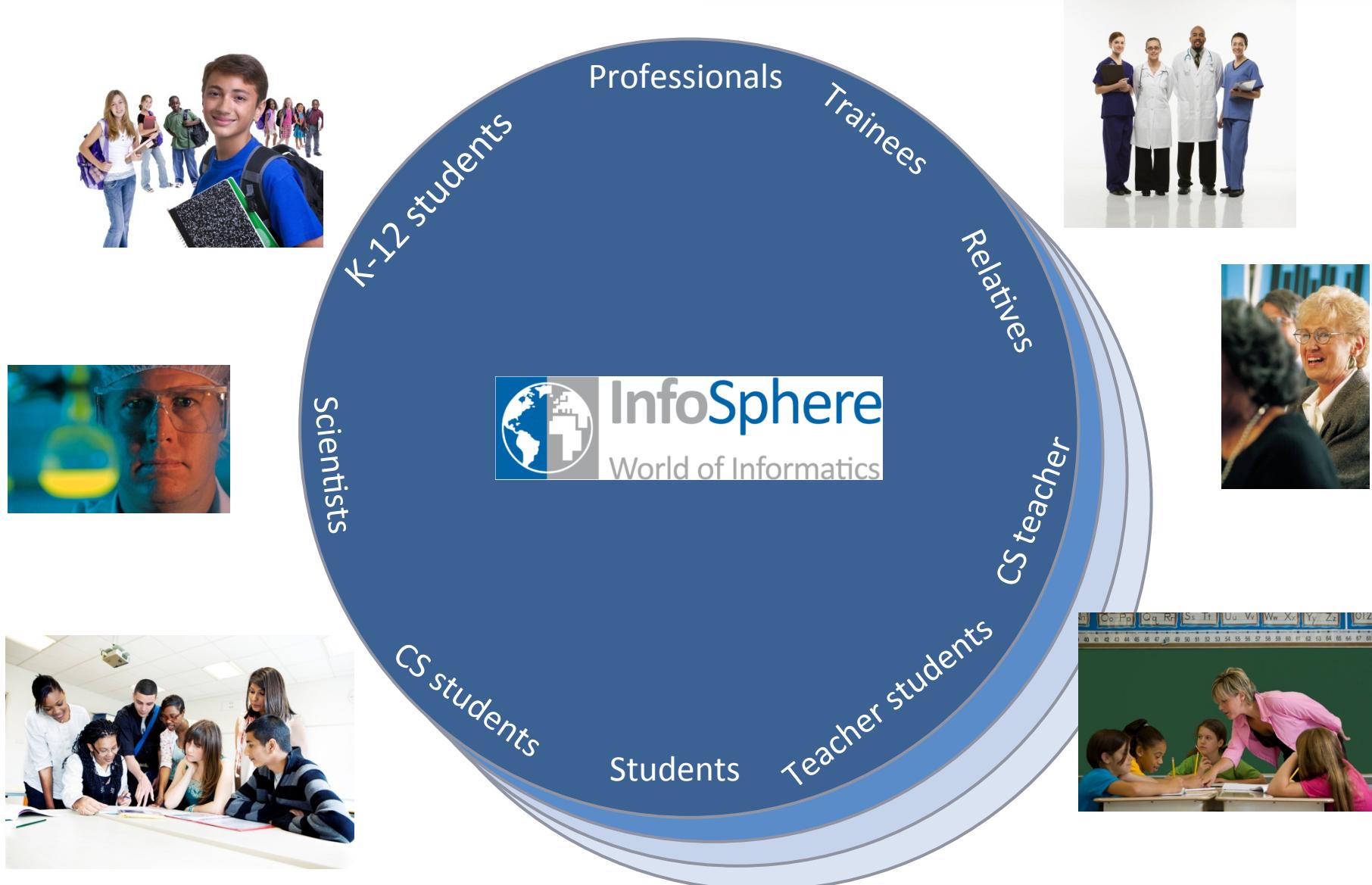
- ▶ Build a small Turing machine with Lego bricks und Lego Mindstorms
- ▶ Practical conduct of mathematical calculations
- ▶ Video documentation of the calculations



# InfoSphere so far



# Future: 4L (Life Long Learning Lab)



# Thanks to ...



Nadine Bergner



Thiemo Leonhardt



Jan Holz

# Questions? Comments?

