Testing Simulated Microworlds in the Teaching of Remote Sensing

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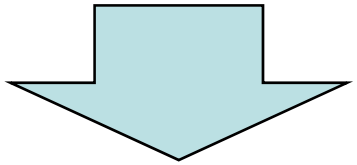
- Background & Motivation
- Objectives
- Conception
- Conclusion

Obstacles when teaching remote sensing principles to students of gepgraphy:

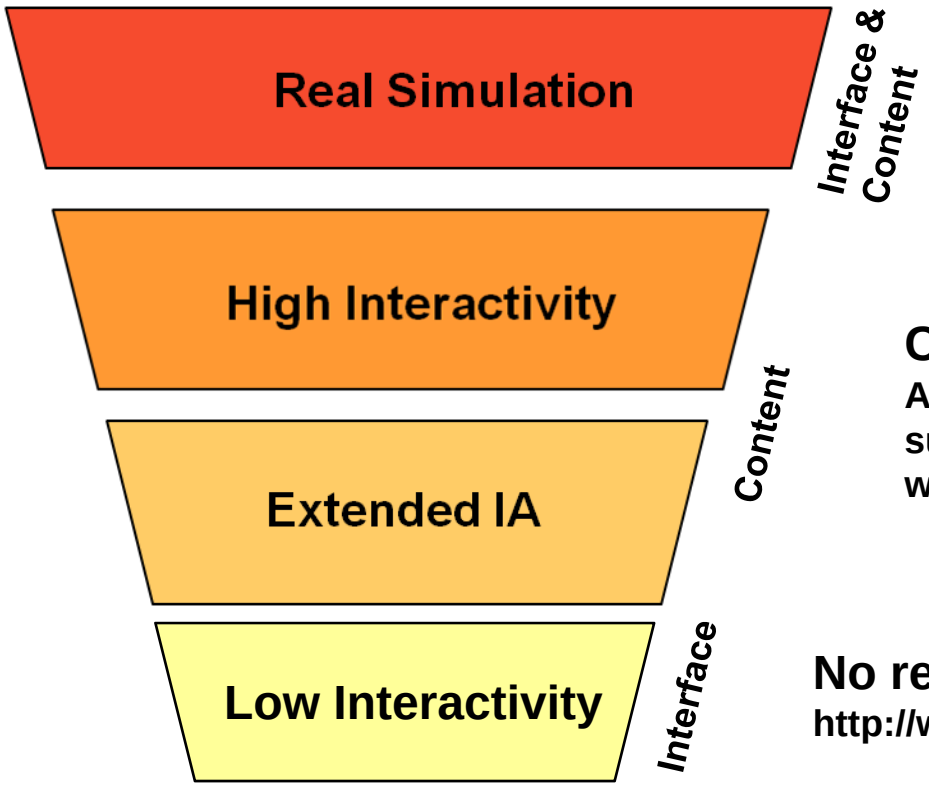
- **Lack of previous knowledge**
- **Strong influences of physics, maths and informatics.**
- **RS topics in general are of an abstract nature**



A lot of students will not understand RS basics
And will not be able value its possebilities!

While the nature of Remote Sensing can not be changed the ways of teaching it can!

Technology enhaced learning offers a broad range of possebilities of which most are barely used in the teaching of remote sensing.



Interaction through simulation

No examples from Germany.
USA :
http://biodiversityinformatics.amnh.org/

Controll interaction

Applications on e-Learning environments such as :web-geo.de, FU Berlin, www.fergi-online.de

No real interaction

http://www.fe-lexikon.info/

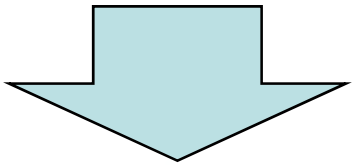
Degrees of Interaction - DIN PAS 1068;2006

Educational Simulation

•A computer program that models some phenomenon or activity and is designed to have participants learn about the phenomenon or activity through interaction.

Microworld

•An interactive, exploratory learning environment of a small subset domain. A microworld can be changed by the user in order to explore the domain and to test hypotheses about the domain. *(R.E.Mayer 2008)*



Simulations do not produce predefined results, as for example, animations do. Simulating a process in RS basicly means working with the same methods as RS – Software does, but "restaging" them inside an educational microworld.

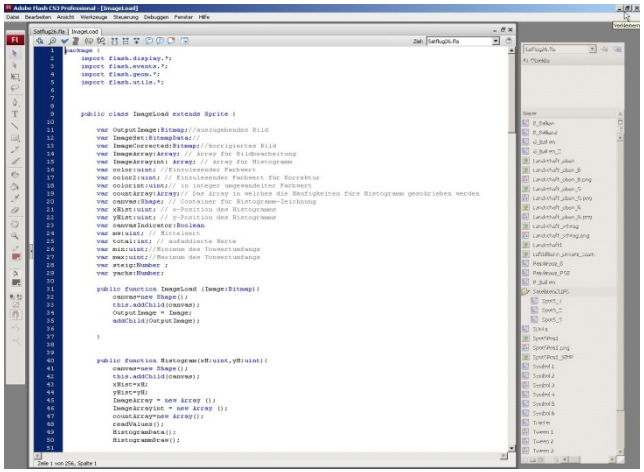
RS- Sensing methods are recreated with the programming language Actionscript 3.0

- *Object oriented programming language*

- *Used for creation of Flash applications -> Easy implementaion into Web-based applications*

- *Applications can be used with the flash browser plug – in or as stand alone applications.*

-*Straightforward creation of individual user Interfaces*



Possebilities to implement advanced methods of display and interaction techniques

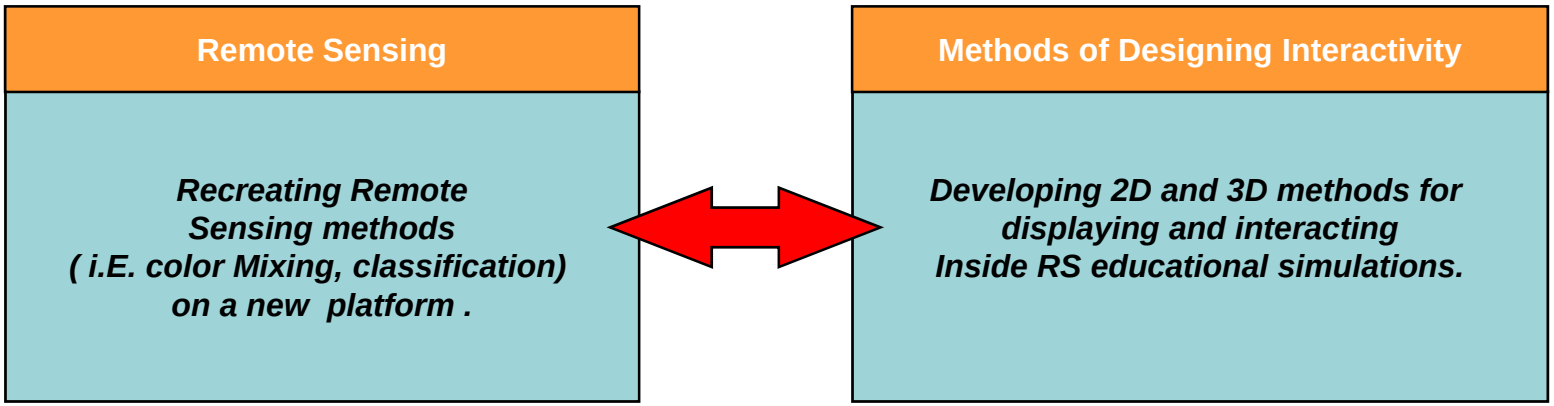
-*3D Display and Interactions through Flash-3D engines*

-*Sandy 3D*

-*Papervison 3D*

-*Away3D*

Objectives:


Remote Sensing
Recreating Remote Sensing methods (i.E. color Mixing, classification) on a new platform .
Methods of Designing Interactivity
Developing 2D and 3D methods for displaying and interacting Inside RS educational simulations.

„There is far more we don‘t know (about simulations) than we do know… We look foward to additional research that narrows our “what we don‘t know“ list“.- R.E.Mayer 2008

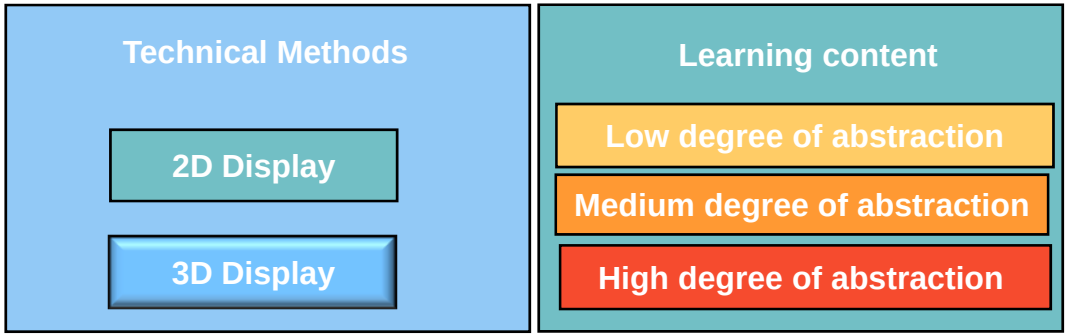
- **Research and experience have already produced certain guidelines on how successfull educational simulations are to be designed.** ***(R.C. Clark; R.E.Mayer; C.Aldrich)***
- **Uncertainty about interface / display design.**
- **Uncertainty about guidance**
- **No research at all has been done on conveying RS principles.**

Objectives

In how far do certain technological methods in simulation applications support the knowledge construction of differently characterised learning content?

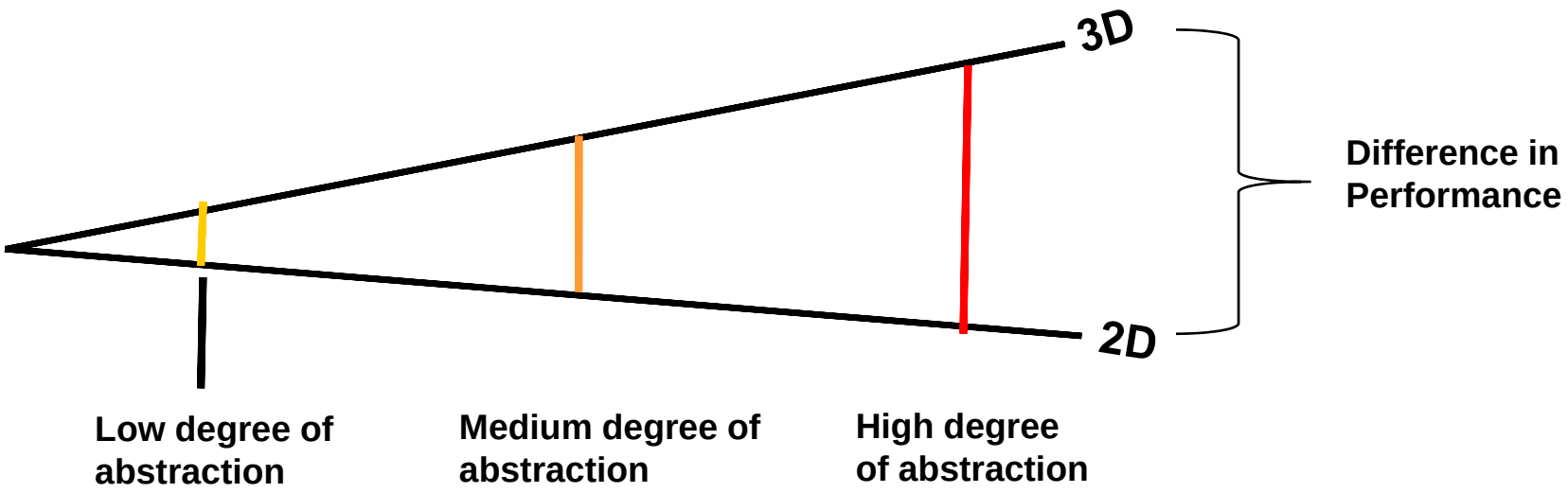
Problem: There is a vast range of technological methods making it impossible to proof connections to differently characterised learning content in the time of this study.

Specialization : The technological methods are reduced to 2D and real time 3D display techniques, while the learning content is clasified in two to three degrees of abstraction.



Objectives

Hypothesis: The use of 2D and real time 3D Display technologies in simulations has an effect on learners performance. The proportions of this effect are connected with the degree of abstraction of the learning content.

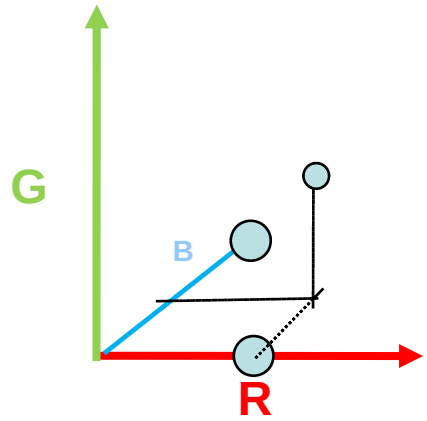


Why should there be a difference?

- **Simulations represent a working mental model of the process to be learned by the user. The user "just" has to reencode the model he is working with into his own mental model.**

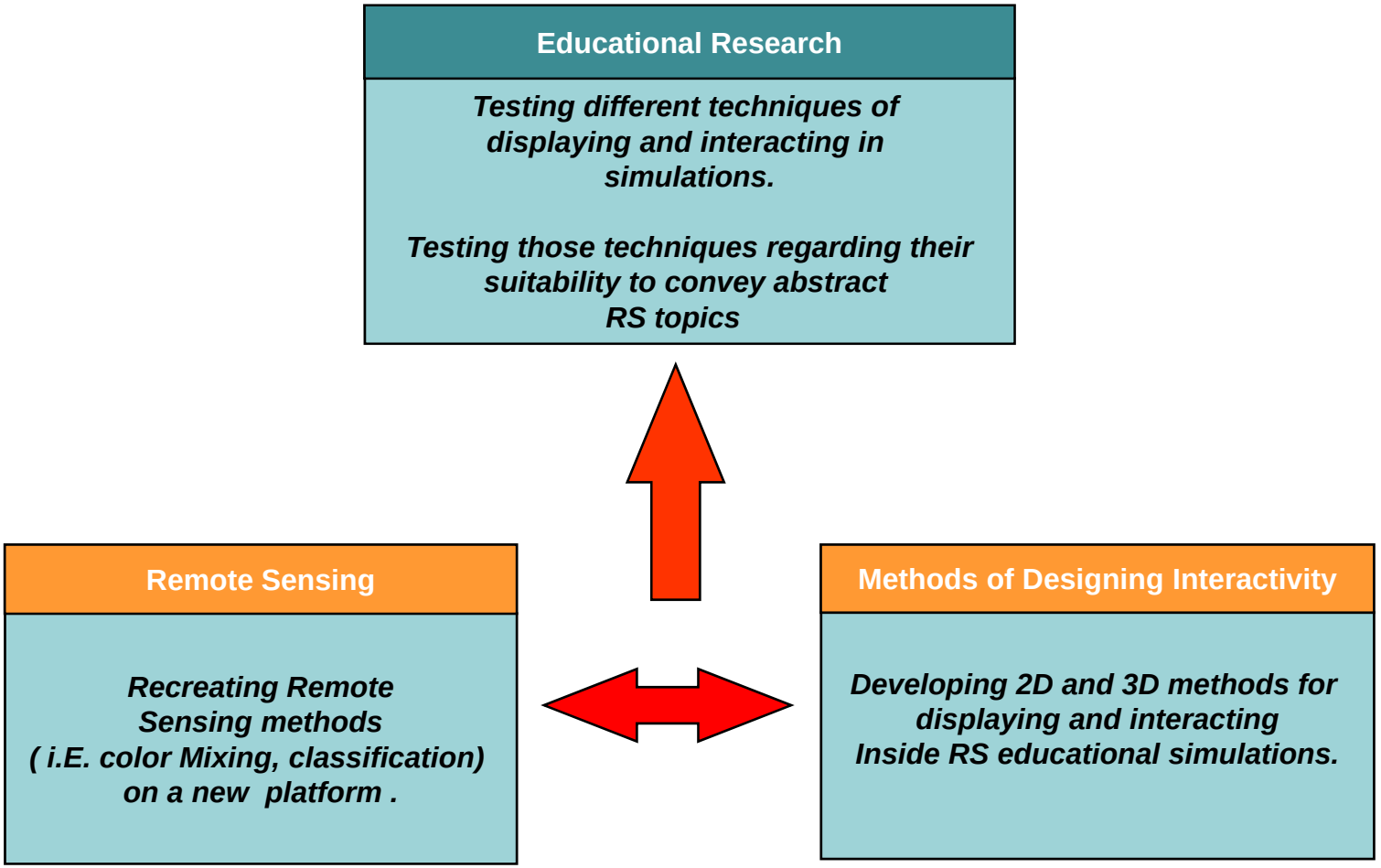
- **Real Time 3D Display offers more possebilities of predefining certain aspects of the model that can not be shown in 2D.**

- **Abstract contents themselves are most often multidimensional.**



- **But: Navigation and interaction in 3D Space may add to cognitive load**

Objectives:


Educational Research
Testing different techniques of displaying and interacting in simulations.
Testing those techniques regarding their suitability to convey abstract RS topics
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Degrees of abstraction and examples

Degree	Low degree of abstraction	Medium degree of abstraction	High degree of abstraction
Definition	•The learning content as well as the simulation still has concrete participants . •No mathematical aspects.	•The learning content as well as the simulation has mostly abstract participants . •Slight mathematical aspects.	•The learning content as well as the simulation has only abstract participants . •Strong mathematical aspects.
Example	Different orbits of satellites	RGB Colormixing	Classification

Test characteristics

- **One 2D and one 3D Simulation will be created for the low, mid and high degree examples - > 6 Simulations**

Low 3D

Low 2D

Med 3D

Med 2D

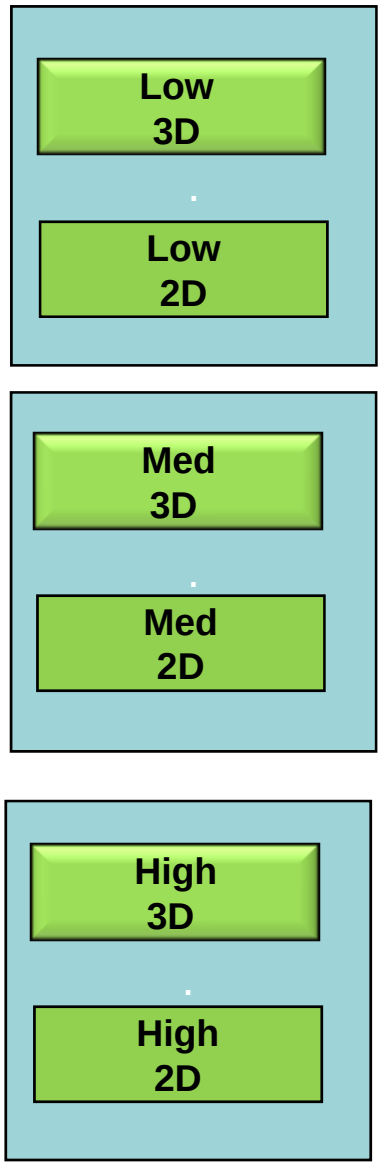
High 3D

High 2D

Test chracteristics

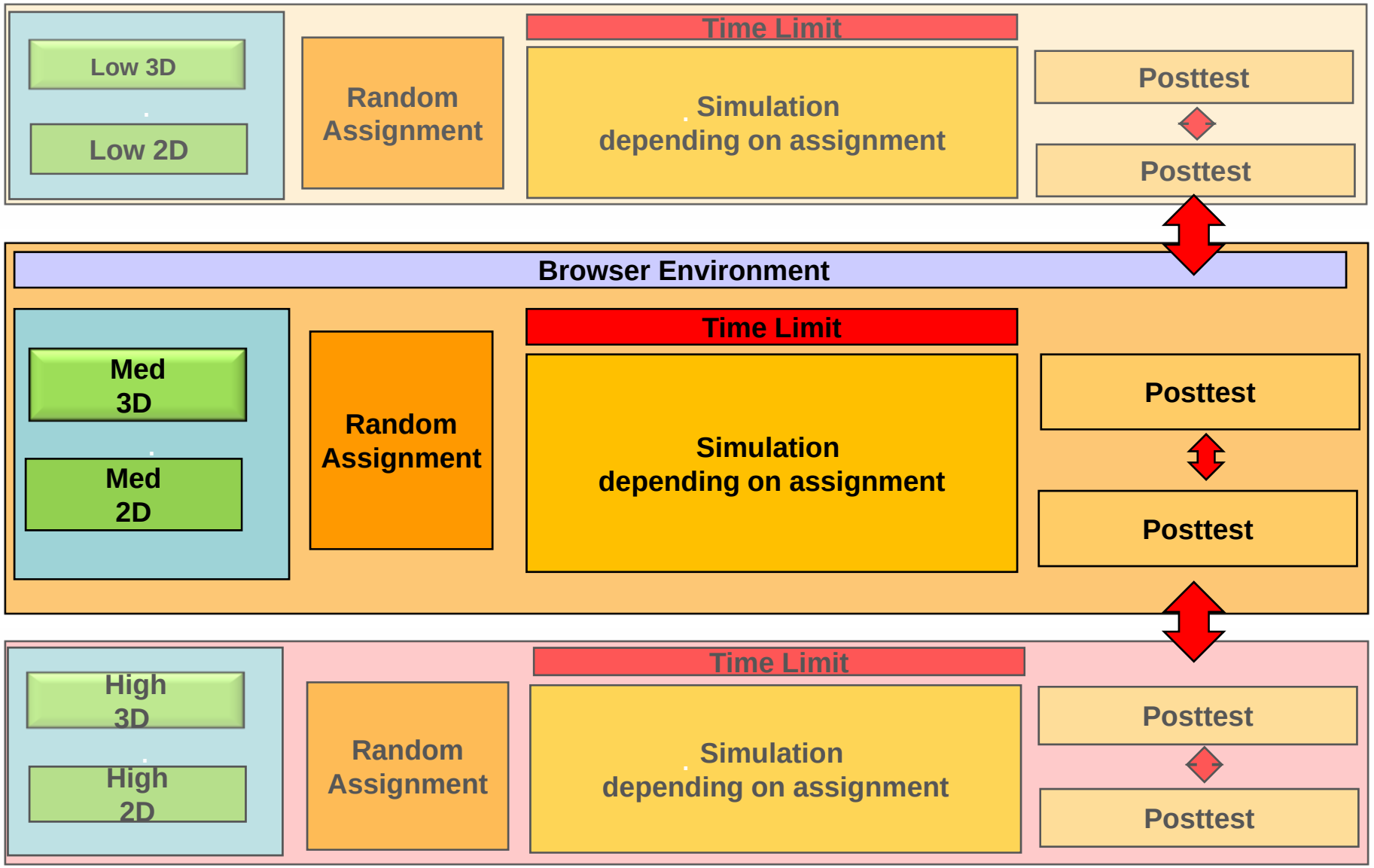
- **One 2D and one 3D Simulation will be created for the low, mid and high degree examples - > 6 Simulations**
- **They will be split into three test – setups each containing the 2D and 3D version for one example.**

Concept



Test chracteristics

- **One 2D and one 3D Simulation will be created for the low, mid and high degree examples - > 6 Simulations**
- **They will be split into three test – setups each containing the 2D and 3D version for one example.**
- **A browser based testing environment will be created for every setup containing:**
  - **Randomized assignment to 2D or 3D group**
  - **Simulation (2D/3D depending on assignment)**
  - **Post Test**


Low 3D
Low 2D
Random Assignment
Time Limit
Simulation depending on assignment
Posttest
Posttest
Browser Environment
Med 3D
Med 2D
Random Assignment
Time Limit
Simulation depending on assignment
Posttest
Posttest
High 3D
High 2D
Random Assignment
Time Limit
Simulation depending on assignment
Posttest
Posttest

Pre-Post Testing?

- **Pretests are always a threat to internal vadility of the resarch. Pretest sensitization.**
- **Previous knowledge is assumed not to be existent in RS. Amongst other things this makes RS such an interresting field for this kind of study**
- **The process of “internal remodeling” is vital when working with simulations. If the partcipants just start looking for the things they have been asked for in the pretest this process could be disturbed.**

Study Environments and participants:

Quantitative A	**1 Sem. Students of Geography participating in seminars at the University of Bonn.** **- retention tests possible!** **- limited number of participants**
Quantitative B	**Open access via internet for first sem. students of other universities.** **- No retention tests possible** **-Theoretically high number of participants**
Qualitative	**Voluntary participants who will be observed while working with the simulation. Progress and reactions will be protocolled.**

Posttest design:

General Questions

Gender: existing studies show differences in the perception of 3D – environments.

Familiar with learning content?: possible exclusion.

Achievement Test:

Questions allowing to determin:

A: Overall performance by ammount of questions solved correctly

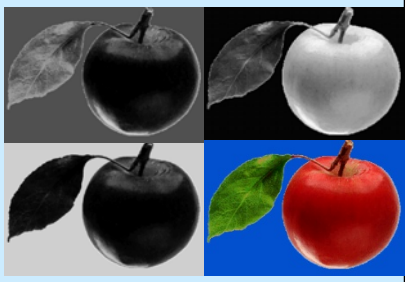
B: Level of content related competence

Basic Level of competence:
Basic facts are learned

How many greyscale images are needed to compute a RGB-color image?

High level of competence:
Working Internal model

Label the grayscale images with R, G or B so they result in the color image shown.



Conclusion

Recommendations for the use of different display and interaction techniques in remote sensing educational simulations.

Prooven conections between technologie and learning content

Working educational simulations for the teaching of remote sensing in universitys

Set of remote sensing related objects and methods for AS 3.0

Educational Research

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Thank you for your attention!

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