Tangible E-Learning

Hauptseminar “E-Learning – Sommersemester 2008

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Agenda

1. Terms and Definitions
2. Motivation for Tangible E-Learning
3. Classification of Tangible Learning Systems
4. Examples of Tangible Learning Systems
5. Effectiveness of Tangible Learning Environments
6. Conclusion

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Terms and Definitions: Tangible E-Learning

Tangible E-Learning enhances e-Learning with the benefits of physicality

Electronically supported learning and teaching aiming to effect the construction of knowledge.

ICTs serve as specific media to implement the learning process

(Tavangarian et al., 2004)

E-Learning

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Tangible User Interfaces

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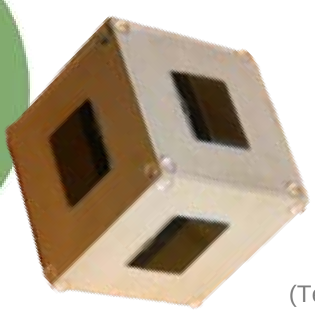
Tangible E-Learning

Electronically supported learning with TUIs as electronic media

Everyday objects or environments that augment the physical world by the digital information they are coupled to

Grasping and manipulation of digital information through objects of the physical space

(Ishii, 1997, Fishkin, 2004)

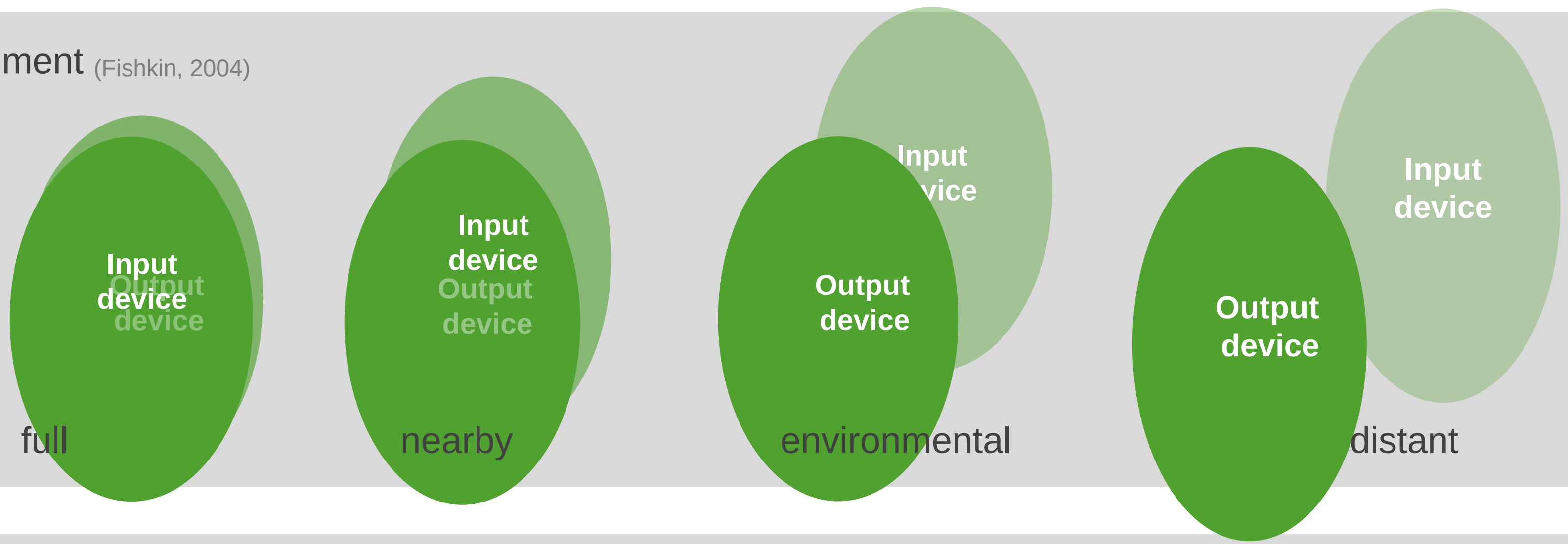


Cube to Learn
(Terrenghi et. al. 2006)

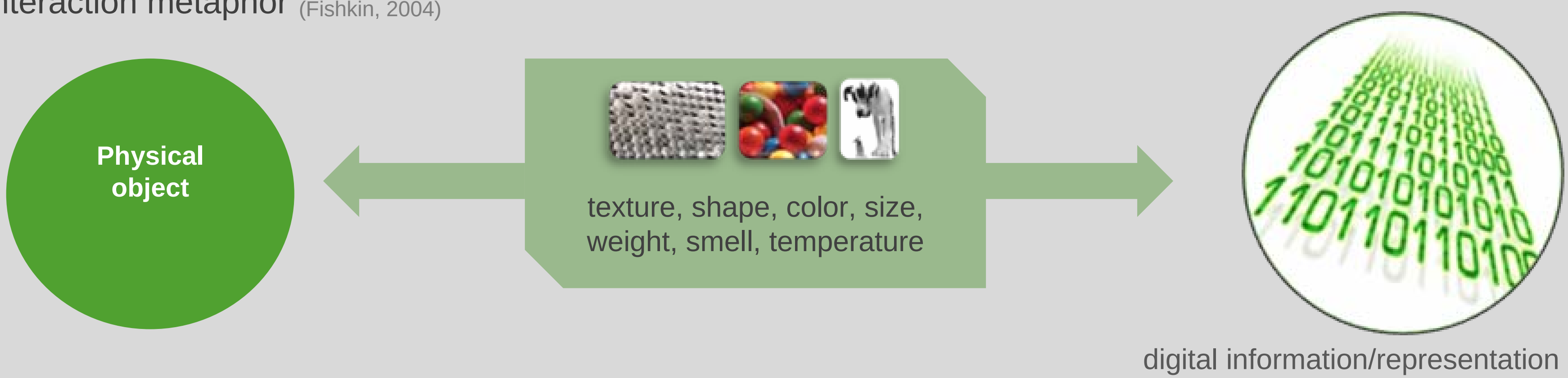
Terms and Definitions: Tangible User Interfaces

TUIs couple objects and digital information through metaphors

Embodiment (Fishkin, 2004)



Interaction metaphor (Fishkin, 2004)



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Motivation for Tangible E-Learning

TUIs are more accessible, increase playfulness and provide extended information

(Resnick et al., 1998)

Cognitive and educational process

Pestalozzi: "things should come before words, concrete before abstract"
(Pestalozzi, 1803)

(Fishkin, 2004)

Metaphor Concept

Principle of noun and verb deeply engrained in human consciousness

Novelty of Links

Flexible combination of manipulatives and digital representation provides more information

(Resnick et al., 1998; Marshall, 2004)

Increased Playfulness

Physical engagement creates involvedness and thus increases motivation and interest

(Marshall, 2004; Price and Rogers, 2004)

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Classification of Tangible Learning Systems

Tangible learning can take place in expressive or exploratory manner

Froebel-Inspired Manipulatives

Expressive Systems

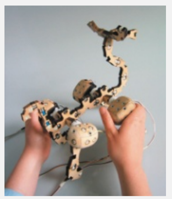
- Based on Froebel's concept from around 1837
- Children get to express their personal understanding of the world
- Constructivist learning

(Zuckerman et al., 2005)

Learners create external representations of their own understanding of a topic and reflect on the accurateness of their representation. (Marshall et al., 2007)

- Best suited to design real-world objects and physical structures (Zuckerman et al., 2005)

Example: ***Topobo***



Montessori-Inspired Manipulatives

Exploratory Systems

- Montessori picked up Froebel's idea and developed it further in 1912
- Put children in control of their learning activity
- They learn through investigation and exploration (Zuckerman, 2004)

Domain experts provide representations, which will be explored by the students by observing the effects of manipulations.

(Marshall et al., 2007)

- Best suited for abstract concepts

(Zuckerman et al., 2005)

Example: ***SmartBlocks***

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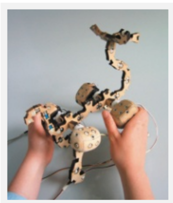
Examples of Tangible Learning Systems: Topobo

Topobo gives basic notions on system dynamics



Topobo

- 3D constructive assembly system
- Coupled with kinetic memory, allowing to record and play back movements of dynamic structural systems

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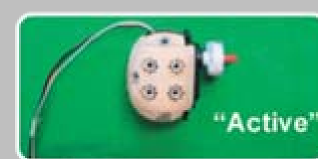

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- Helps children understand
  - how balance, leverage and gravity affects moving structures
  - relative motion and the difficulty of coordination

- Children build their own representation and afterwards examine it critically in terms of accurateness

(Raffle et al., 2004)

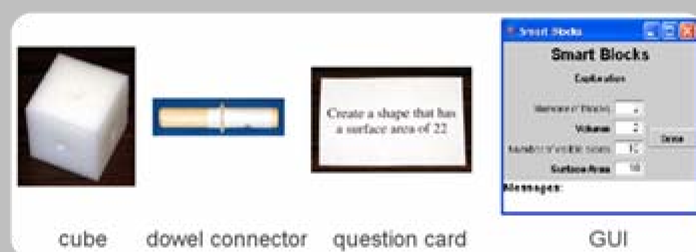
Examples of Tangible Learning Systems: SmartBlocks

SmartBlocks helps understand the concepts of surface and volume of 3D objects

Exploratory Tangible Learning

SmartBlocks

- Digitally augmented mathematical manipulative
- Combines physical manipulation with real-time feedback to enhance the learning process



- Children learn about mathematical concepts on volume and surface of 3D objects
- They can explore the impact of a changing shape on its volume and surface area and get an idea of the relationship of number of blocks to volume and number of blocks to visible sides

- A geometry expert provides a representation that children explore by manipulation

(Girouard et al., 2007)

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Effectiveness of Tangible Learning Environments

Tangibles have overall more benefits but this is poorly empirically proven

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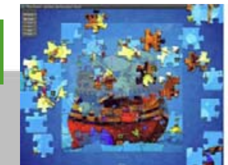
The Hazard Room

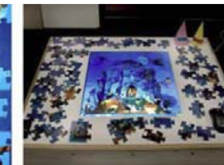
Learning effectiveness

(Fails et al., 2005)

- Physical environments show clear advantages over desktop environments
- In tangible environments:
  - Increased answer depth and higher subjective interest
  - Higher mean score differential between pre and post tests

Jigsaw Puzzle





Fun and engagement

(Xie et al., 2008)

- Children's self-report of enjoyment similar for both TUI and GUI ***but***
- More difficulties with GUI interaction
- In tangible environments:
  - Active participation and collaboration
  - Less quitting, higher number of repeated plays

higher effectiveness of **Tangible Learning Systems**

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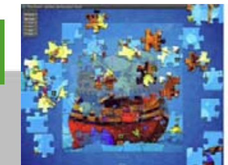

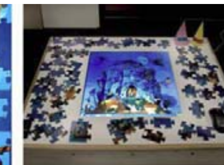

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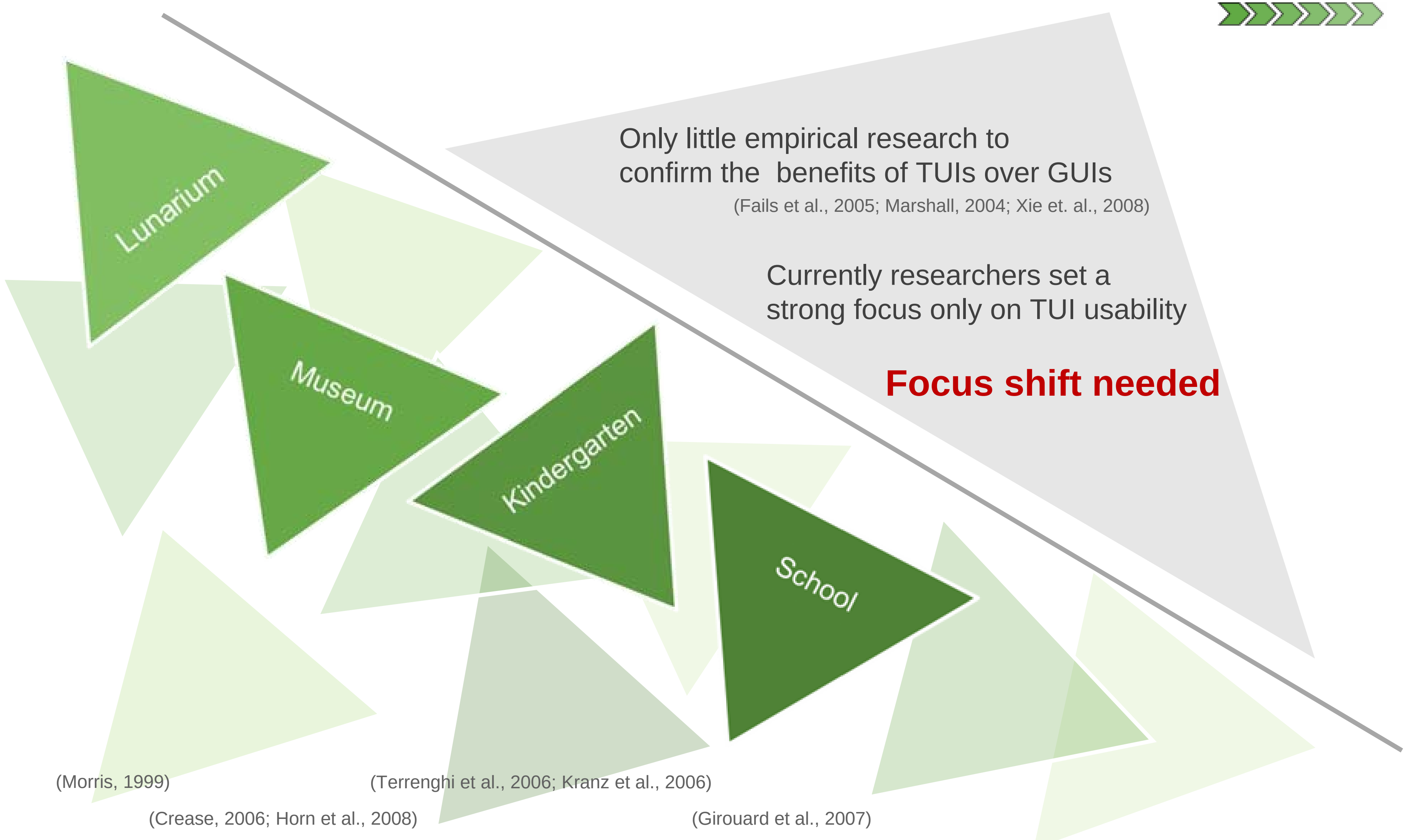
Conclusion

TUIs apparently have strong potential but more empirical work is needed



Only little empirical research to confirm the benefits of TUIs over GUIs

(Fails et al., 2005; Marshall, 2004; Xie et. al., 2008)

Currently researchers set a strong focus only on TUI usability

Focus shift needed

(Morris, 1999)

(Terrenghi et al., 2006; Kranz et al., 2006)

(Crease, 2006; Horn et al., 2008)

(Girouard et al., 2007)

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