



Pedagogical Reasoning in Mobile Technologies

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Research interests on m-learning

mutual encouragement

affective domain

enjoyment

student engagement

infrastructure

teachers' abilities

students' perceptions

distraction

learning outcomes

attitudes

designing systems

motivation

science experiments

m-health

engagement

educational context

What literature shows

“The incorporation of mobile technology and pervasive learning can enhance the effectiveness and accessibility of learning activities in the future”.

(Shuib, L., Shamshirband, S., Ismail, M.H. (2015). A review of mobile pervasive learning: Applications and issues. *Computers in Human Behavior*, 46, 239-244).

“... it is timely to explore the future of science learning in light of the distinctive features of mobile-intensive pedagogies. ... There is a need for science educators to understand the nature of learning in mobile contexts”.

(Burden, K., Kearney, M. (2016). Future Scenarios for Mobile Science Learning. *Research in Science Education*, 46, 287-308).

“... further research regarding the use of mobile technologies in all areas and levels of science learning will help science educators to expand their ability to embrace these technologies”.

(Crompton, H., Burke, D., Gregory, K.H., Gabel, C. (2016). The Use of Mobile Learning in Science: A Systematic Review. *Journal of Science Education and Technology*, 25, 149-160).

What literature shows

“Future studies need to make use of newer, available technologies; ... Researchers need to make more explicit connections between the instructional principles and the design features of their mobile learning environment ... stronger alignment is needed between the underlying theories and measured outcomes”.

(Zydney, J.M., Warner, Z. (2016). Mobile apps for science learning: Review of research. *Computers & Education*, 94, 1-17).

“... more elaborate instructional design developments are needed to more thoroughly exploit the educational benefits possible by utilizing mobile devices”.

(Sung, Y., Chang, K., & Liu, T. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers & Education*, 94, 252-275).

“Informal learning is the most preferred approach carried out along with M-Learning”.

(Chee, K. N., Yahaya, N., Ibrahim, N. H., & Noor Hassan, M. (2017). Review of Mobile Learning Trends 2010-2015: A Meta-Analysis. *Educational Technology & Society*, 20(2), 113–126).

Search for m-learning 2007-2017

- ❖ ACM Digital Library 13,3325
- ❖ ERIC 198
- ❖ IEEE *Xplore* 510
- ❖ JSTOR 295
- ❖ ScienceDirect 112
- ❖ SpringerLink 166
- ❖ Taylor & Francis Online 108
- ❖ Wiley Interscience 106

THE EXPERIMENT



**experimental
group**



**control
group**

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You cannot understand,

Instructional design

Technological features

Learning affordances

4G

Semi-experiment

System design

Zone of proximal development

you will never understand,
you do not even try.

mLMS

<http://blog.backyardbrains.com/2014/04/mending-love-the-human-human-interface-is-now-available/>

“All these technologies seemed to hold the potential of changing the way teachers teach and students learn. And yet they never seemed to live up to their potential.

Why?

Part of the reason lies with the conservative nature of education”.

“Mobile Pedagogy if you will, will become an integral part of this new ecosystem”.

(McConatha, D., Penny, C., Schugar, J., Bolton, D. (2014). *Mobile Pedagogy and Perspectives on Teaching and Learning*. USA: IGI Global).

“... ‘seamless learning’, ... may be the most significant factor in encouraging educators to rethink their existing pedagogical patterns”.

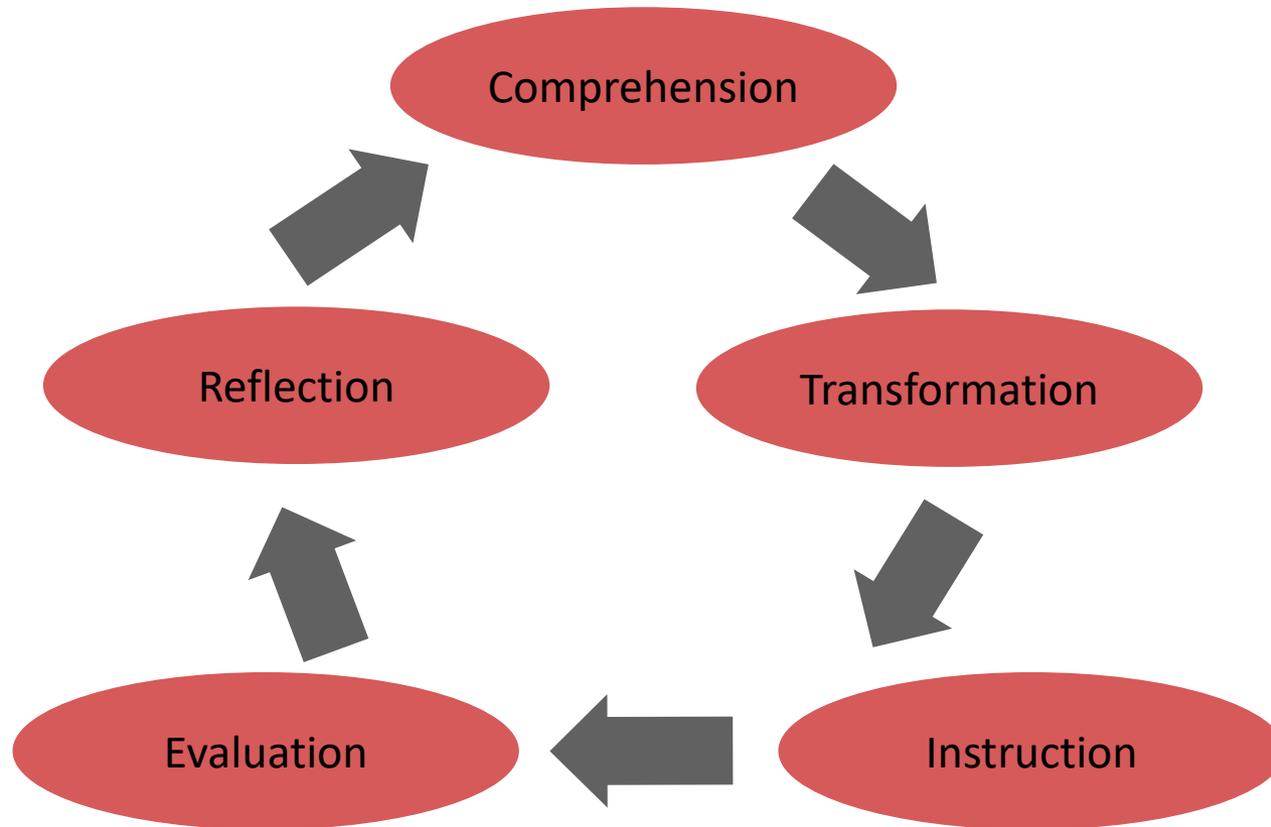
(Burden, K., Kearney, M. (2016). Future Scenarios for Mobile Science Learning. *Research in Science Education*, 46, 287–308).



We are one, inextricably linked, now and forever. Your movements guide my movements, my life guides your life.

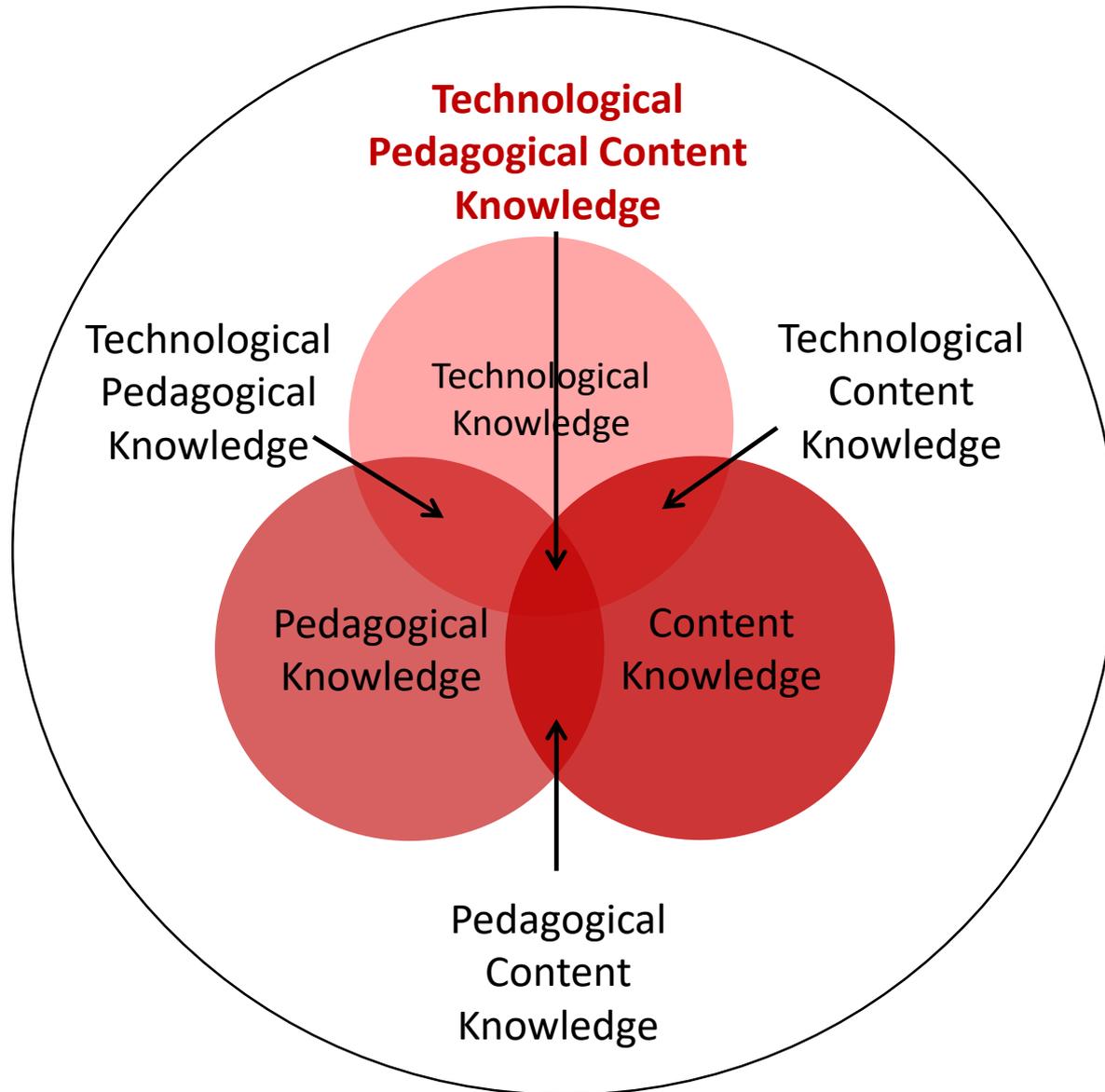
<http://blog.backyardbrains.com/2014/04/mending-love-the-human-human-interface-is-now-available/>

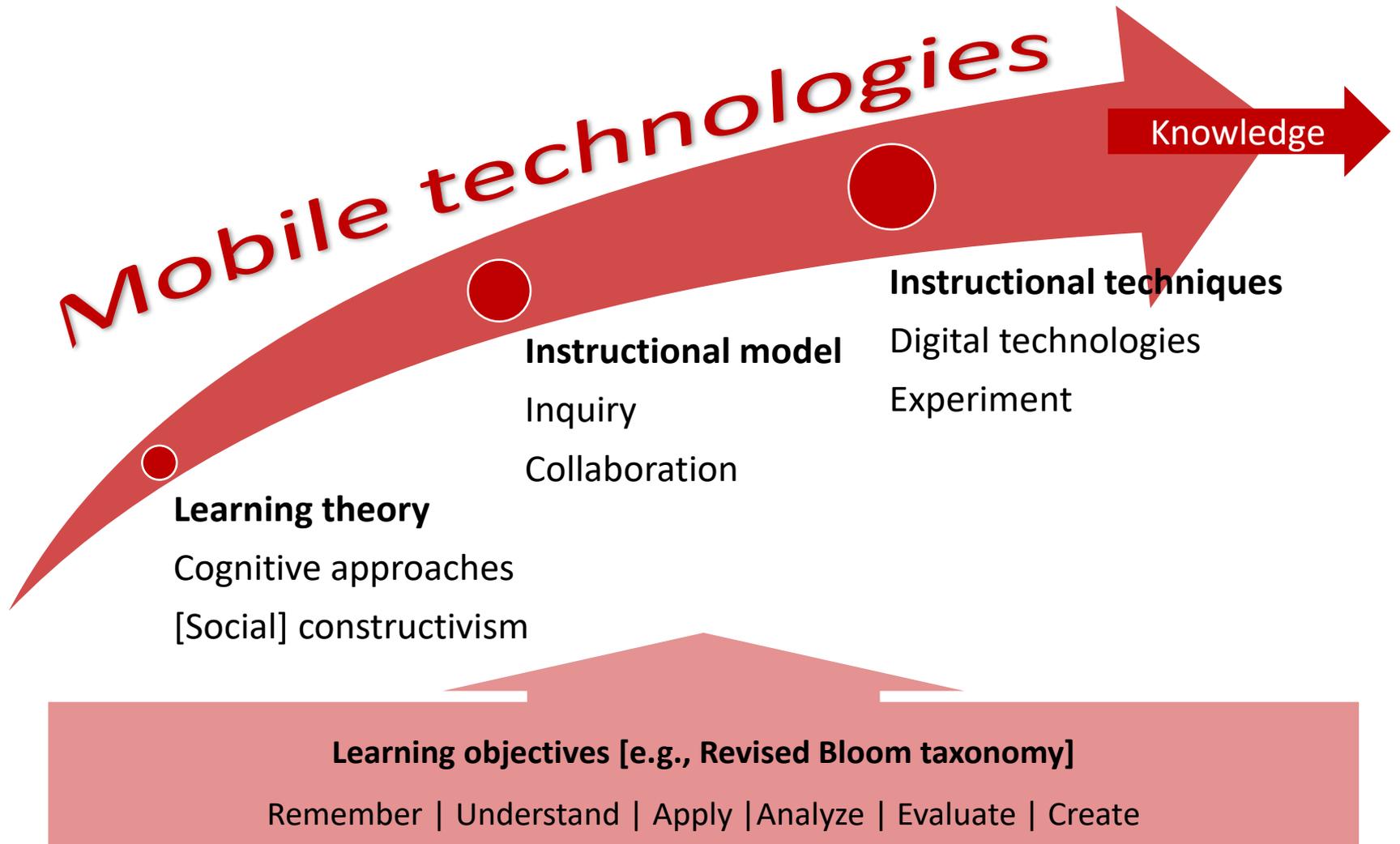
Pedagogical reasoning



(Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1-22).

Pedagogical reasoning, PCK and TPACK





Pedagogical use of digital technologies

Unique technological features / attributes / characteristics

They record and store data and information

They process data and information fast

Unique
characteristics for
learning

Representations

Multimodal
Dynamic
Interactive

Communication

Synchronous
Asynchronous

Characteristics and affordances

Technological characteristics have certain potentials,
they afford certain actions.

Technologies, such as mobile technologies, involve certain affordances.

The unique [technological] affordances
lead to unique learning affordances.

[Unique] learning affordances lead to certain learning activities.

Affordances

“An affordance signifies the perception of the environment of an agent in terms of the actions that can be afforded by it”.

(Gibson, J.J. (1979). The ecological approach to visual perception. Mahwah, NJ: Lawrence Erlbaum Associates, Inc).

“Affordances are “the actions permitted an animal by environmental objects, events, places, surfaces, people, and so forth”.

(Michaels , C.F. (2003). Affordances: Four Points of Debate. Ecological Psychology, 15(2),135-148).

“Affordance is the property of objects to convey “important information about how people could interact with them””.

(Norman, D. A. (2013). The design of everyday things. New York: Basic Books).

Affordances

“Affordances “exist independent of being perceived” and “are specified by information and may be perceived”.

Affordances “are not defined with respect to particular animal effectivities”, “the properties of the animal that allow that action to take place in the environment””.

(Michaels , C.F. (2003). Affordances: Four Points of Debate. *Ecological Psychology*, 15(2),135-148).

Why affordances are important?

“The success with which technology is utilised for learning and teaching depends on the educator's ability to appreciate the requirements within the learning context and subsequently select and utilise technologies in a way that meets those needs”.

(Bower, M., Sturman, D. (2015). What are the educational affordances of wearable technologies? *Computers & Education*, 88, 343-353).

“Many of the technologies available for educative purposes have not been designed specifically for learning and teaching, and thus the educator needs to analyse the affordances and constraints of such technologies to creatively repurpose them for the educational context”.

(Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: a framework for teacher knowledge. *Teachers College Record*, 108(6), 1017-1054).

Affordances of mobile technologies

Geotagging, media recording capabilities, communications tools.

(Cochrane, T., & Bateman, R. (2010). Smartphones give you wings: pedagogical affordances of mobile Web 2.0. *Australasian Journal of Educational Technology*, 26(1), 1-14).

Portability, social interactivity, context, and individuality.

(Klopfer, E., & Squire, K. (2008). Environmental Detectives: the development of an augmented reality platform for environmental simulations. *Educational Technology Research and Development*, 56(2), 203-228).

Portability, Availability, Locatability, Multimediality.

(Schrock, A.R. (2015). Communicative Affordances of Mobile Media: Portability, Availability, Locatability, and Multimediality. *International Journal of Communication*, 9, 1229–1246).

Flexible use, continuity of use, timely feedback, personalisation, socialisation, self evaluation, active participation, peer coaching, sources of inspiration outdoors, cultural authenticity.

(Kukulska-Hulme, A., Viberg, O. (2017). Mobile collaborative language learning: State of the art. *British Journal of Educational Technology*, doi:10.1111/bjet.12580).

Affordances of mobile technologies

Pedagogical uses	Educational quality	Logistical and other implications
In situ contextual information	Engagement	Hands-free access
Recording	Efficiency	Free up spaces
Simulation	Presence	
Communication		
First-person view		
In situ guidance		
Feedback		
Distribution		
Gamification		

(Bower, M., Sturman, D. (2015). What are the educational affordances of wearable technologies? *Computers & Education*, 88, 343-353).

Affordances of mobile technologies

But

“Affordances are latent in the environment, objectively measurable and independent of the individual’s ability to recognize them, but are always in relation to the actor” (see individuality, engagement, etc.).

(Gibson, J.J. (1979). The ecological approach to visual perception. Mahwah, NJ: Lawrence Erlbaum Associates, Inc).

“Affordance is the property of objects to convey “important information about how people could interact with them”” (see socialization, educational quality, etc.).

(Norman, D. A. (2013). The design of everyday things. New York: Basic Books).

Affordances of mobile technologies

and

In order to get the optimum effect of a technology, in our case mobile technology, we have to distinguish its unique affordances.

The design of applications in every domain has primarily to be based on the unique affordances of the particular technology, in our case mobile technology.



Of course, other affordances, common with other relevant technologies, may follow and be used.

Affordances of mobile technologies

The example of VR and MUVES

1. Multisensory intuitive and real time interaction
2. immersion
3. Presence
4. Autonomy
5. Natural semantics for the representation of objects and facts
6. Users' representation through avatars
7. First-person user point of view
8. First-order experiences
9. Size in space and time
10. Transduction and reification.

(Mantziou, O., Papachristos, N.M., Mikropoulos, T.A. Learning activities as enactments of learning affordances in MUVES: A review-based classification, to be published).

The unique affordances of mobile technologies

1. Ubiquity and pervasiveness
2. Geolocation
3. Sense
4. Finger control.



Learning affordances of mobile technologies

Mobile technologies incorporate these unique affordances of ubiquity and pervasiveness, geolocation, sense, and finger control, thus, they afford certain actions that lead to corresponding learning activities.

Therefore, there is a need to classify affordances that contribute to learning, namely learning affordances, as well as their association with learning activities.

Often used terms are “educational” and “pedagogical” affordances.

The term “educational affordances” involves not only the cognitive domain (learning), but also affective and psychomotor domains, as well as social and other issues.

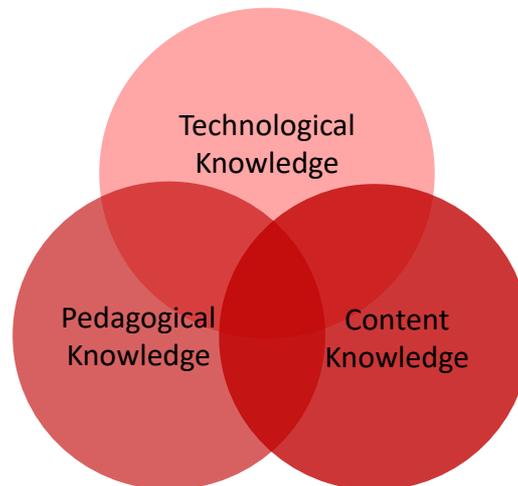
For mobile technologies that involve the above domains, we prefer the more general term “educational” rather than “learning” affordances.

Educational affordances of mobile technologies

Educational affordances lead to learning benefits when they are supported by a solid theoretical framework.

Following the TPACK model, the educational affordances have to come from the merging of its three components that is technological, pedagogical, and content knowledge.

The [technological] affordances are incorporated into the technological knowledge circle of the TPACK model.



Educational affordances and activities

“Educational affordances are those characteristics of an artifact that determine if and how a particular learning behaviour could possibly be enacted within a given context”.

(Kirschner, P. A. (2002). Can we support CSCL? Educational, social and technological affordances for learning. In P. A. Kirschner (Ed.) (pp. 7–47). Heerlen, The Netherlands: Open University of the Netherlands). *Three worlds of CSCL: can we support CSCL?*

Pedagogical affordances provide “opportunities for exploration and manipulation to foster the construction of new knowledge”.

(Dickey, M. D. (2003). Teaching in 3D: Pedagogical affordances and constraints of 3D Virtual Worlds for synchronous distance learning. *Distance Education*, 24(1), 105-121).

Educational affordances of mobile technologies

Thus, we classify the following educational affordances that result from the [technological] affordances of mobile technologies:

1. Creation (geolocation, sense, finger control)
2. Experimentation (geolocation, sense, finger control)
3. Real-time/anytime/anywhere information and content presentation and delivery (ubiquity and pervasiveness, sense, finger control)
4. Collaboration and cooperation (ubiquity and pervasiveness, geolocation)
5. Multichannel communication (ubiquity and pervasiveness, geolocation)

Learning activities in Science Education

To validate the five unique educational affordances of mobile technologies, we have to associate them with learning / educational activities as appear in empirical studies.

An exhaustive review on empirical studies since 2000 in the fields of:

Physics

Chemistry

Biology

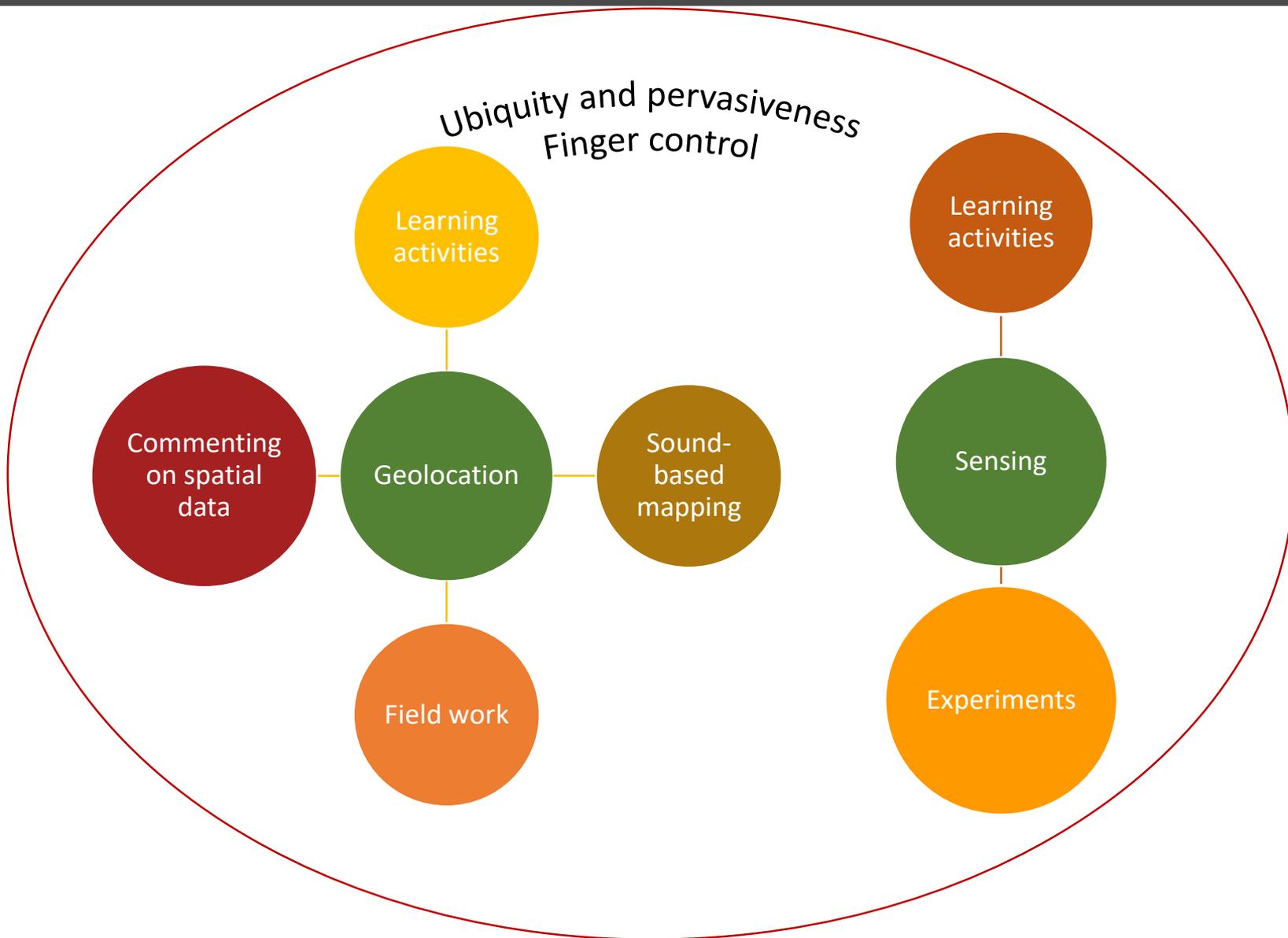
Geography

Environment

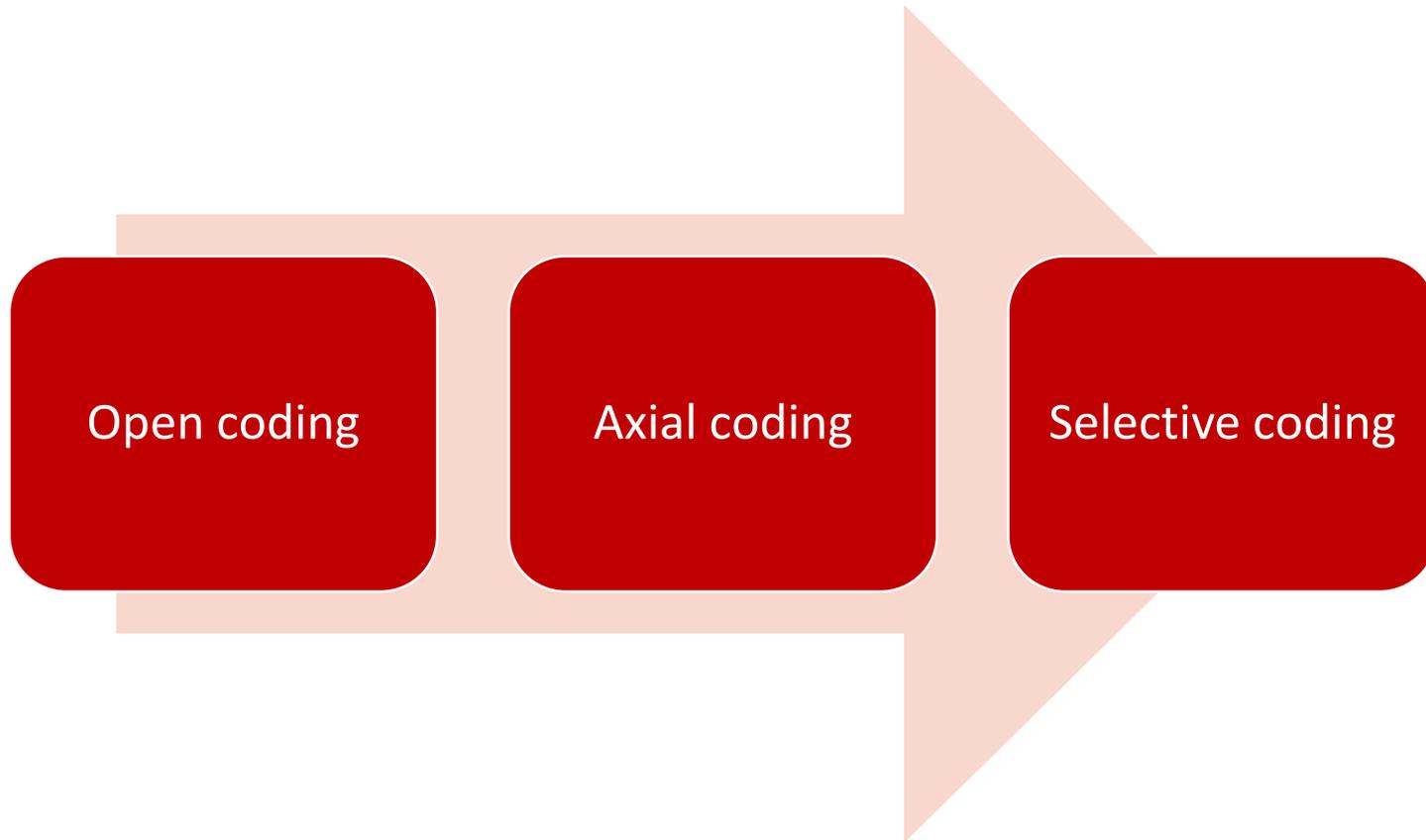
Learning activities in Science Education

Experiments from distance
Games
Access to information through www
Podcasting **Tutorials and quizzes**
Gamification Picture taking
Multiple representations Field trips
Geolocation-based design 3D molecular representations
Biological data bases Chemistry calculations
Note taking
Virtual Labs **Argumentation through SMSs**
Experiments with sensors
Video recording **Content delivery**

Learning activities in Science Education



Classification of the educational activities



(Wolfswinkel, J.F., Furtmueller, E. & Wilderom, C.P.M. (2013). Using Grounded Theory as a Method for Rigorously Reviewing Literature. *European Journal of Information Systems*, 22, 45–55).

Classification of the educational activities

Selective coding

1. Content creation
2. Content exploration and interaction with content
3. Social interaction
4. Experimentation
5. Gaming

The selective coding learning activities give a more general level of abstraction that wouldn't enable any changes.

This helps to associate learning activities to learning affordances.

Activities and associated learning affordances

Learning activities	Learning affordances
Content creation	Creation
Content exploration and interaction with content	Real-time/anytime/anywhere information and content presentation and delivery
Social interaction	<ul style="list-style-type: none">• Collaboration and cooperation• Multichannel communication
Experimentation	Experimentation
Gaming	<ul style="list-style-type: none">• Real-time/anytime/anywhere information and content presentation and delivery• Collaboration and cooperation• Multichannel communication

Learning theories and strategies followed

- Contextualized learning
- Problem based approach
- Zone of proximal development
- Authentic learning
- Inquiry based learning
- Collaborative learning
- Constructionism

Why do we need affordances and educational affordances?

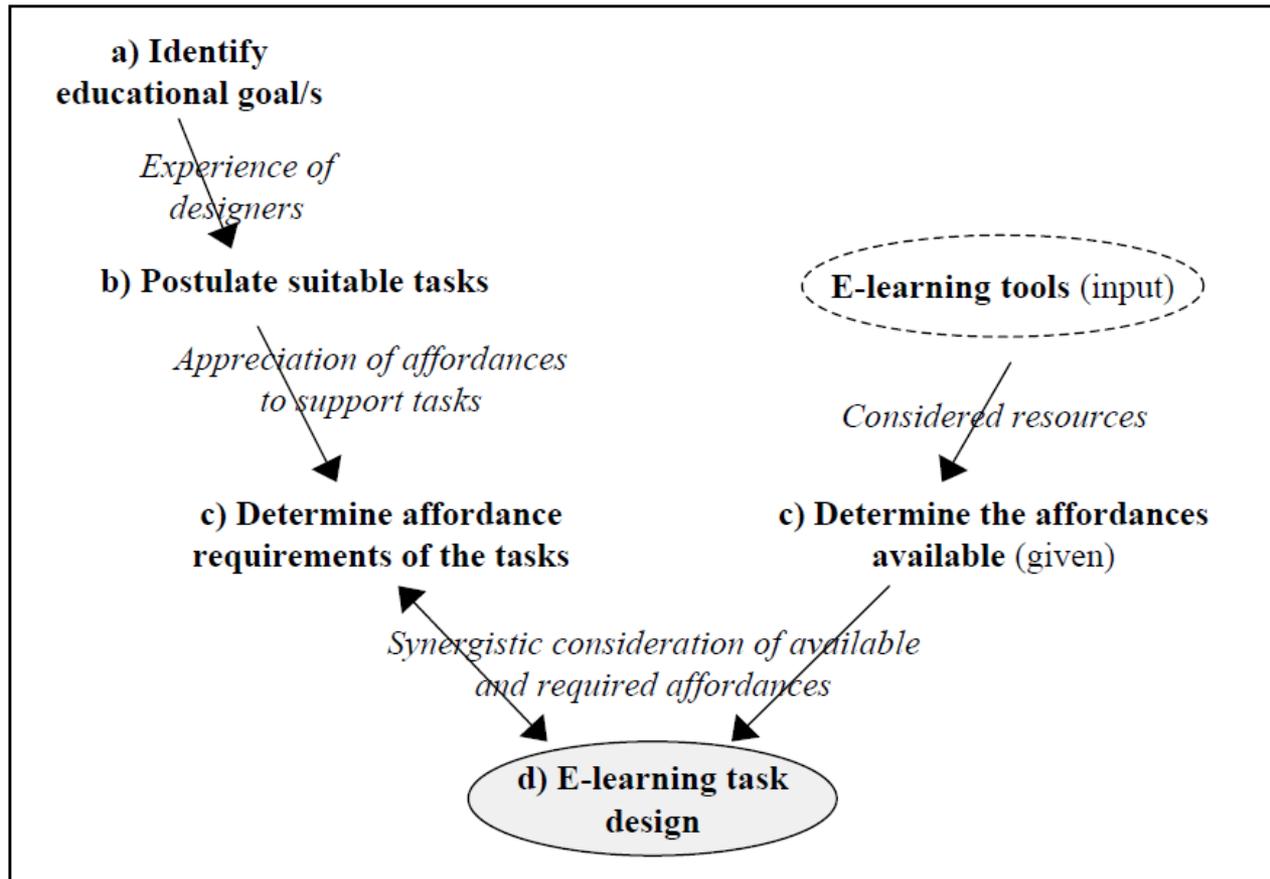


Figure 1. The affordance analysis e-learning design methodology: matching tasks with technologies to construct e-learning designs.

(Bower, M. (2008). Affordance analysis-matching learning tasks with learning technologies. *Educational Media International*, 45(1), 3-15).

m-learning

Affordances

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2. Geolocation
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Educational affordances

1. Creation
2. Experimentation
3. Real-time/anytime/anywhere information and content presentation and delivery
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