

Perspectives on use of technology in physics education

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Learning and thinking is about establishing experiential human - world relationships.

Human experiences of our lifeworld are shaped by physical and symbolic tools (mediating tools). A common denominator in the design of many "innovative" learning environments is the insightful and careful application of computer based measurement technology as a mediating tool.

Human \longleftrightarrow Artefact \longleftrightarrow World

Figure 1. The role of artefacts as a mediating tool in human perception.

Our research has shown that the way these tools are designed and implemented is critical for learning outcomes.

Philosophy of technology deals with such questions as what role does technology (artifacts) play in everyday human experience:

- How do technological artifacts affect the existence of humans and their relations with the world and within our world?
- How do artifacts produce and transform human knowledge and how are human knowledge included in artifacts?
- What are the actions of artifacts?

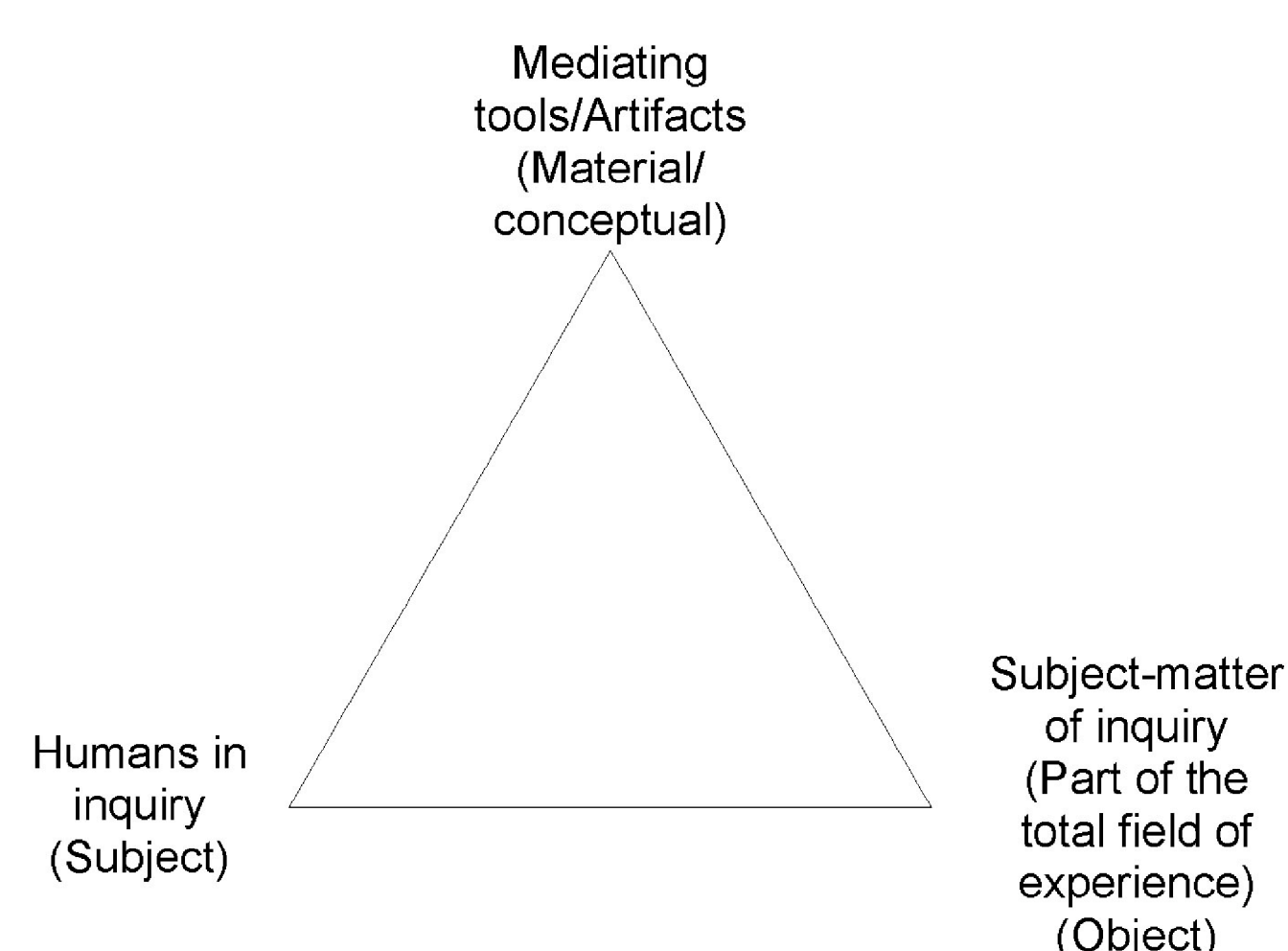


Figure 2. A model showing the concept of mediation adapted and modified from Vygotsky (1978) and Cole (1996): The triadic relationship between subject - mediating tools - object illustrating that the relation is transformed by mediation.

The philosopher of technology Ihde have developed in his post-phenomenology the following schematic distinctions regarding the intentional relationship between humans and their world:

Embodiment relations:

(Human \leftrightarrow Technology) \leftrightarrow World

Hermeneutic relations:

Human \leftrightarrow (Technology \leftrightarrow World)

Alterity relations:

Human \leftrightarrow Technology (\leftrightarrow World)

In embodiment relations we are not normally aware of the technology. In hermeneutic relations some kind of interpretation is involved, hence the term hermeneutic. Both in embodiment and hermeneutic relations experience is transformed by the mediating technology used.

The way technologies are implemented in the relation Human \leftrightarrow Technology \leftrightarrow World shape figure - background relations, i.e. which critical factors for learning are possible to dis-

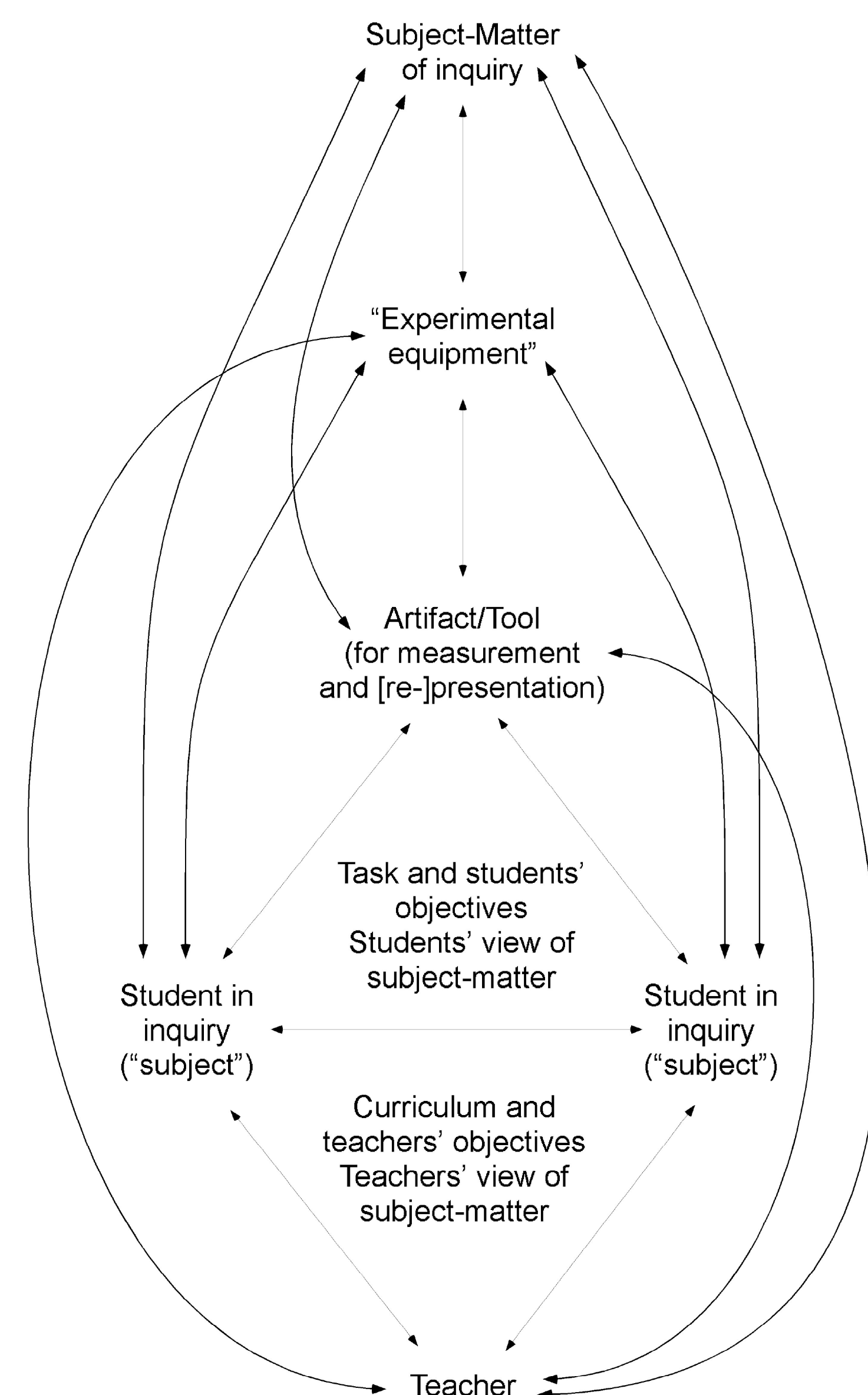


Figure 3. A schematic model of encounters and framing of activities in MBL-labs. The model shows several triadic relations and is an extension of the model presented in Figure 2.

cern for students. Cuban (2001), however, noted that "[i]n most cases, teachers used the new technology to maintain existing practices".

The so-called Microcomputer Based Laboratory (MBL) is an example of the use of "interactive technology" as a tool for learning in physics education. Students' activities in the MBL-labs have been studied by video recording and studying their orientation to, interpretation, and participation in these labs. Students' courses of action is framed by different experiences. From our empirical data we see that these are framed by encounters with the instructions, the technology, the teacher and other students. In order to solve the task the students have to deal with certain concepts in certain ways. It should be noted that the technology is present in all encounters.

Our results give examples of learning environments where the use of technology to create tools for mediation is essential for the design of the learning environment and the resultant educational achievements. In an earlier study (Bernhard, 2003) I have, however, refuted technological determinism and shown that the educational implementation is crucial.

The problems reported with some applications of computers in education are probably because theories of mediation and the available tools are not properly understood.



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