Researching Microcomputer Technologies in Mathematics Education: The Philosophical Foundations of Technocentricism and Sociocentricism, and Implications for Research

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Overview

- The purpose of this paper is to provide insight into the philosophical foundations of research that concentrates on the use of microcomputer technology in mathematics education

Outline

- Rationale for the study
- Describe technological determinism
  - Use its themes as a lens to examine the nature of the research paradigm guiding a body of work in mathematics education
  - Coin a new term, technocentricism, to carve out a place for philosophical discussion
  - Discuss its philosophical assumptions
- Describe social constructivism and its philosophical assumptions
- Discuss implications of my analysis for mathematics education research

Rationale for the study

- Studies on microcomputer technologies in mathematics education are abundant

- However reflection on the philosophical foundations of this research is rare

- Underlying philosophical assumptions operate at a broad abstract level and guide the design of research studies (Creswell, 1998; Denzin & Lincoln, 2000)

Technological determinism

- Determinism: "[E]verything is caused (determined) by a sequence of previous conditions and events, operating with regularity and, in principle, predictability" (Pannabecker, 1991, p. 3).

- Technological determinism: Technology is the autonomous and primary force for changes in society

Technological determinism: Two themes

- Technology as the autonomous and primary force for the changes in society
  - Technological determinism as an essentialist argument: "[S]ome inherent property or characteristics of technology accounts for the impact of technology on our lives" (Grint & Woolgar, 1997, p. 6)
  - Notion of "technological impacts"
- Formative aspect (Coyne, 1997; Pea, 1985)

Views on the effect of technology

- Technology is neutral
  - Complete separation of means (technologies) and ends (needs)

- Technology is formative
  - Means and ends cannot be not separated
  - Idea of "cognitive technologies" (Pea, 1985)

The two themes

- Technology, because of its inherent features, is the primary force of change
- Technology has formative power

The technological determinist direction in mathematics education research

- James Fey (1989), Kathleen Heid (1997), and David Shaffer and James Kaput (1999)
- Technocentricism
  - Microcomputer technology, because of its inherent features, is the primary force in transforming mathematics education
  - Microcomputer technology has a formative aspect

Technocentricism as a continuum

Light technocentricism   Strong technocentricism

Fey (1989)   Heid (1997)   Shaffer & Kaput (1999)

The nature of the research paradigm implied by technocentricism

Assumption	Question	Technological determinism	Technocentricism
Ontological	What is the nature of reality?	Realist ontology: reality exists independent from the researcher	Microcomputer technology as a phenomenon exists independent from the researcher
Epistemological	What is the relationship between the inquirer and the known?	Objective epistemology	Researcher can study microcomputer technology using an objective analysis
Methodological	How do we know the world, or gain knowledge of it?	Experimental/manipulative; verification of hypotheses	Chiefly quantitative methods of inquiry

Outline

- Rationale for the study √

- Describe technological determinism √
  - Use its themes as a lens to examine the nature of the research paradigm guiding a body of work in mathematics education √
  - Coin a new term, technocentricism, to carve out a place for philosophical discussion in mathematics education √
  - Discuss philosophical assumptions √
- Describe social constructivism and its philosophical assumptions
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An alternative view: Social constructivism

- Technologies as cultural artifacts: their meaning is socially constructed rather than being evident from the outset

- Technology is not an external/autonomous force on society that implies inevitable changes

- Change is contingent and emergent, rather than being something that can be determined (Hine, 2000; Pinch & Bijker, 1987)

Philosophical assumptions of social constructivism and sociocentricism

Assumption	Question	Social constructivism	Sociocentricism
Ontological	What is the nature of reality?	Relativist ontology: Multiple constructed realities	We cannot talk about microcomputer technology apart from people and contexts
Epistemological	What is the relationship between the inquirer and the known?	Interpretive epistemologies: The knower and known interact and shape one another	Researcher can study microcomputer technology through an interpretive process
Methodological	How do we know the world, or gain knowledge of it?	Interpretive, naturalistic methods	Qualitative methods of inquiry: ethnography, case study, phenomenology, etc.

Implications for mathematics education research

- Choosing the right theory?
- The "social" and the "technical" as coexisting worlds

Two general questions

- How does the technical affect certain uses and interpretations?

- How does the social give rise to certain designs but not to others?