

Identifying and Remediating Student STEM Misconceptions

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Agenda

- Definitions and Background
- Assessment Strategies
- Remediation Strategies
- Questions and Comments

What is a Concept?

- Mental constructs, models, or schema which help us organize knowledge
- Abstracted from instantiations
- Critical to the development of higher order cognitive skills
 - Analyzing
 - Creating
 - Evaluating

Bransford, Brown, and Cocking (2000)

What is a Misconception?

- Also referred to as
 - Alternative framework
 - Alternative conception
 - Naïve or invented theory
- Develops from a flawed development process
 - Knowledge construction
 - Knowledge bundling
- Typically represents deeply held beliefs
- Can be resistant to change
- Misconception *v.* mistake

Mestre (2004)
Posner, et al. (1982)
Schnittka and Bell (2010)

One Coping Mechanism



Constructivism

- Philosophy of education and learning
- We construct our own understanding of the world we live in
- People generate their own “rules” and “mental models,” which are used to make sense of our experiences
- Learning is the process of adjusting mental models to accommodate new experiences
- Learning is affected by context as well as beliefs and attitudes

Davidson (2006)
Prince and Felder (2006)

Inductive Methods

- Inquiry
 - Structured
 - Guided
 - Open
- Problem-based
- Project-based
- Case-based
- Discovery
- Just in Time

Prince and Felder (2006)

Conceptual Change

- Change will not happen unless there is a compelling reason to do so
- Success in modifying or replacing a misconception depends on the degree to which the replacement concept
 - Is comprehensible and plausible
 - Solves problems consistently
 - Allows learners to add to their knowledge through questioning and experiences

Posner, et al. (1982)

STEM Misconceptions

- [Seasons](#)
- [Equal Sign](#)

- [Science misconceptions](#)
- [Technology misconceptions](#)
- [Technology misconceptions 2](#)
- [Engineering misconceptions](#)
- [Math misconceptions](#)

Misconceptions in DLD

- Base n ($n \neq 10$) conversion and operations
- Duality
- Gate input
- Karnaugh maps
- Sequential design
- States
- Three input XOR
- Two's complement representation and manipulation

Herman and Handzik (2010)
Herman, Zilles, and Loui (2009)
Herman, Loui, and Zilles (2010)
Longino, Loui, and Zilles (2006)

Assessment Strategies

- Concept inventories
 - [Foundation Coalition](#)
 - [Purdue's Concept Inventory Central](#)
- Directed interviews
- Exposing event creating cognitive conflict
- Strategy writing
- Think-aloud

Leonard, Dufresne, and Mestre (1996)

Mestre (23008)

Nussbaum and Novick (1982)

Prince and Felder (2006)

Streveler, et al. (2008)



Remediation Strategies

- Bridging
- Discrepant events
 - Goal is to create an opportunity for accomodation
 - [Diet Coke example](#)
- Inductive teaching/learning strategies and activities
- Interactive lectures
- Models (visualization)

Bransford, Brown, and Cocking (2000)
Chi (2005)
Prince and Felder (2006)



Questions / Comments?

Thank you!

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