A Design Tool

For engineering science exhibits

Marianne Mortensen
Department of Science Education
University of Copenhagen

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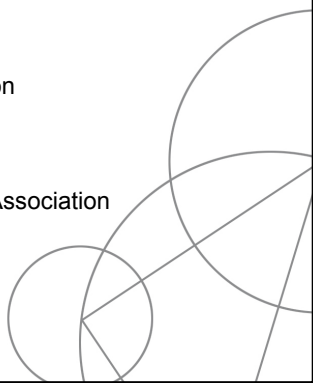


Agenda

- Why do we need tools for science exhibit design?
- A descriptive or diagnostic tool
- A prescriptive or design-oriented tool
- Final remarks

Why do we need tools for exhibit design?

Case: an exhibit about Charles' Law

Charles' Law: heating up a gas also increases the volume of that gas. If the pressure is unchanged, the density of the gas will decrease (it will expand) making it 'lighter'.

Intended learning outcome: The balloon goes up because the air inside is heated and the pressure equalised to the ambient level; the expansion of the air gives it a lower density than the ambient air, causing the balloon to rise.

Hot Air Balloon at the Knowledge Science Center in Lisbon, Portugal

(Botelho & Morais, 2006)

Why do we need tools for exhibit design?

Case: an exhibit about Charles' Law

Realised learning outcome: *the hot air is made up of lighter particles which are forced go up into the atmosphere, and when the balloon fills with hot air it goes up*. [Asked about what elements make the balloon go up] *Carbon dioxide, which results from the heating of the air.*

Hot Air Balloon at the Knowledge Science Center in Lisbon, Portugal

(Botelho & Morais, 2006)

We need tools for exhibit design!

Additional examples from the literature

- An interactive exhibit intended to address naïve notions about gravity in some cases **taught the misconception** (Borun & Adams 1991; Borun Massey & Lutter 1993)
- Students described the results of their interaction with a science exhibit in ways that **reflected their expectations rather than their actual experiences** (Kerrison & Jones 1994)
- Based on their interactions with single science exhibits, students constructed knowledge that was **unexpected and not in accord with canonical science** (Anderson Lucas Ginns & Dierking 2000)
- In an astronomy museum, students constructed **unintended interpretations** of an exhibit intended to show the seasons of the Earth (Falcão et al. 2004)

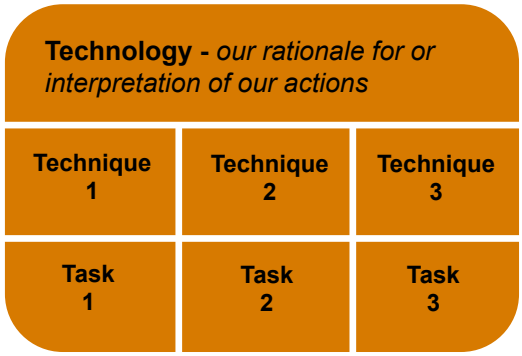
A diagnostic tool for exhibit design

Praxeology – a model of human activity

Chevallard (2007)

A diagnostic tool for exhibit design

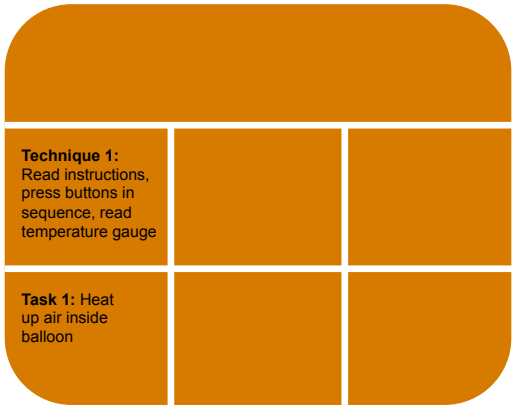
Praxeology – a model of human activity



Chevallard (2007)

A diagnostic tool for exhibit design

The intended praxeology in the Hot Air Balloon



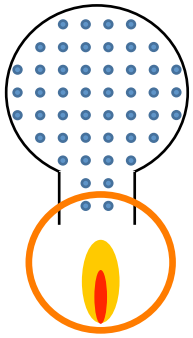
Hot Air Balloon at the Knowledge Science Center in Lisbon, Portugal

(Botelho & Morais, 2006)

A diagnostic tool for exhibit design

The intended praxeology in the Hot Air Balloon

Technique 1: Read instructions, press buttons in sequence, read temperature gauge		
Task 1: Heat up air inside balloon	**Task 2:** Perceive that heating air and equalising pressure decreases air density	

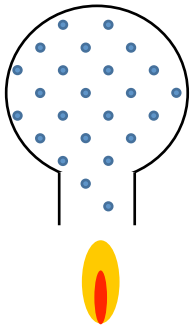


Task 2

A diagnostic tool for exhibit design

The intended praxeology in the Hot Air Balloon

Technique 1: Read instructions, press buttons in sequence, read temperature gauge	**Technique 2:** Observe balloon ascend as a result of heating air	
Task 1: Heat up air inside balloon	**Task 2:** Perceive that heating air and equalising pressure decreases air density	



A diagnostic tool for exhibit design

The intended praxeology in the Hot Air Balloon

Technology: Heating air and letting it expand makes it less dense ("lighter"); Cooling air and letting it contract makes it more dense ("heavier") (Charles' Law)		
Technique 1: Read instructions, press buttons in sequence, read temperature gauge	**Technique 2:** Observe balloon ascend as a result of heating air	**Technique 3:** Observe balloon descend after time lapse
Task 1: Heat up air inside balloon	**Task 2:** Perceive that heating air and equalising pressure decreases air density	**Task 3:** Realise that cooling air and equalising pressure increases air density

A diagnostic tool for exhibit design

The realised praxeology in the Hot Air Balloon

Technology: Heating up air changes its characteristics, making it lighter (somehow)		
Technique 1: Read instructions, press buttons in sequence, read temperature gauge	**Technique 2:** Observe balloon ascend as a result of heating air	**Technique 3:** Observe balloon descend after time lapse
Task 1: Heat up air inside balloon	**Task 2:** Realise that heating air makes it rise	**Task 3:** Realise that cooling air makes it fall

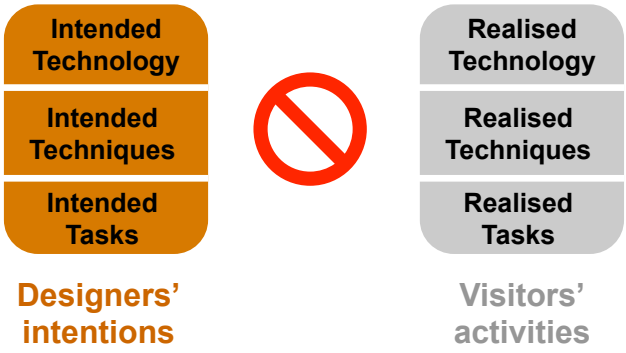
The hot air is made up of lighter particles which are forced go up into the atmosphere, and when the balloon fills with hot air it goes up.

Hot Air Balloon at the Knowledge Science Center in Lisbon, Portugal

(Botelho & Morais, 2006)

A diagnostic tool for exhibit design

Using praxeology to diagnose the Hot Air Balloon



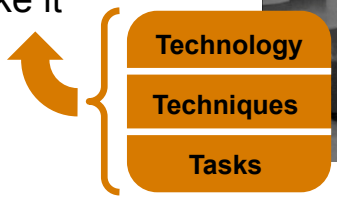
If we agree that **praxeology** can be used to **describe** the activities and resulting interpretations an exhibit ***can*** generate...

...can we then also use **praxeology** to **prescribe** the kinds of activities and interpretations an exhibit ideally ***should*** generate?

A prescriptive tool for exhibit design

Praxeology as an answer to a question

Why does increasing the temperature of a gas (under constant pressure) make it lighter?



A prescriptive tool for exhibit design

Praxeology as an answer to a question

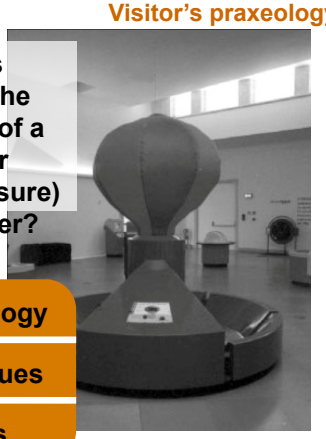
Scientist's praxeology

Visitor's praxeology

Jacques Charles (1746-1823)

Technology
Techniques
Tasks

Why does increasing the temperature of a gas (under constant pressure) make it lighter?



Technology
Techniques
Tasks

A prescriptive tool for exhibit design

Scientist's praxeology

To find out why heating a gas makes it lighter, I keep the pressure and mass constant. As I increase the temperature, I monitor the volume of the gas.

Jacques Charles (1746-1823)

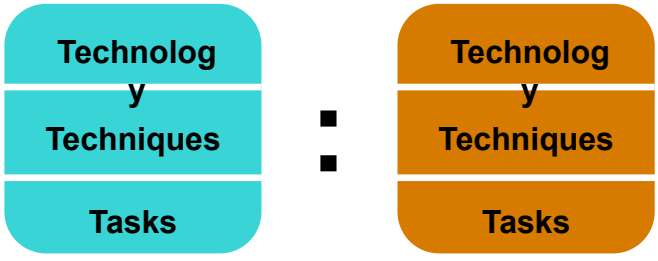
A prescriptive tool for exhibit design

Scientist's praxeology

Technology: Charles' Law		
Technique 1	**Technique 2**	**Technique n**
Task 1: Maintain constant pressure and mass of a quantity of gas	**Task 2:** Increase gas temperature and monitor volume	**Task n...**

A prescriptive tool for exhibit design

Praxeology as a template for exhibit design



Scientist's praxeology

Visitors' prospective praxeology

Cf. Brousseau (2002)

Final Remarks

- The notion of praxeology may be used descriptively or prescriptively in exhibit design
- Praxeology is a way to systematise the process of exhibit design, but also a way to generate new ideas for exhibit design
- Praxeology is a suggestion for a theoretically-based tool for a practice that has typically been under-theorised

Cited Literature

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