A comparison of different levels of interactions when using the isolated-element strategy

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Background (1/2)

Isolated interacting elements effect :

= learning elements are presented in isolation without indicating the manner in which they interact before presenting the full interacting material (e.g. Sweller, 2010)

– is superior to presenting the full interacting material twice (Pollock, Chandler & Sweller, 2002; Ayres, 2006)

– has been compared or interpreted as
  • pre-training effect (Mayer, Mathias & Wetzell, 2002; Clarke, Ayres & Sweller, 2005)
  • simple-to-complex sequencing (van Merriënboer, Kester & Paas, 2006)
  • molar-modular effects (Gerjets, Scheiter & Catrambone, 2006)
  • the use of subgoals (Catrambone, 1998)

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Studies referenced above share one important feature:

- it's more efficient to acquire knowledge about components before learning the whole than trying to learn the whole directly

But

- our analysis suggest that the promising idea to break down the complexity by isolation of the interacting element is not always implemented in the same manner:

> sometimes components are presented in isolation form with no interaction between them

> sometimes components are presented in isolation but with some interactions still present

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Previous experiments

Bellec & Tricot, 2010, 2011

> The two experiments shows no difference between “elements before whole” and “whole before elements” presentations, even if:

– Exp.1: small learning effect
– Exp.2: big learning effect

> Order seems to have a no role with our material

> It seems possible to hypothesize that isolated interacting elements effect is actually linked to isolation and not to the presentation order

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Aim

The aim of this study was to compare 3 modes of presentation of a system from its element:

> isolated elements with no interactions before a presentation of the whole interacting system
> partially interacting elements before a presentation of the whole interacting system
> a direct presentation of the whole interacting system

And tested if the isolated interacting elements effect can be considered as

> a general effect of simplification of the whole interacting system

or

> if it's more closely linked to the isolation of interacting elements rather than simplification

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Method (1/2)

Participants: 43 students of a technical college from Poitiers (France) randomly assigned to one version of the material.

Learning support: a computer based material with a 2-stages design about the effectiveness of hybrid engines as a solution to the reduction of greenhouse gas emissions (9 components or variables in interaction).

Versions of presentation:

> Non interacting strategy: Stage 1 with strong isolation of the components or variables and stage 2 presentation of the whole interacting system.
> Partially interacting system: Stage 1 with presentation of components or variables in interaction between them and stage 2 presentation of the whole interacting system.
> Total interacting strategy: Stage 1 with a presentation of the whole interacting system and stage 2, the same presentation.
Method (2/2)

Pre-test: 29 questions to evaluate the students prior knowledge one week before the passations
   > 20 questions for a future recall
   > 9 questions for a future transfert

Post-test: same as the pre-test

Measure of mental effort: 9 points Lickert scale after each learning phases
thermal-electric hybrid motor: a complex system

Organization

Four driving situations:
- start-up
- braking
- driving at constant speed
- strong acceleration

Two sources of energy available (or not available):
- petrol in the tank
- electric energy in the battery

Variables: strength, power, kinetic energy, torque, consumption, production of carbon by gas, transformation of energy electrical <-> mechanical, electric energy storage

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thermal-electric hybrid motor : levels of presentation of kinetic energy

The non interacting strategy

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thermal-electric hybrid motor : levels of presentation of kinetic energy

The partially interacting strategy

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> No significant difference between the 3 conditions for recall questions

> For transfer questions, a significant difference between the non interacting condition and total interacting condition (total interacting was superior)

> No significant difference between the 3 conditions for the mental effort invested in phase 1 but a significant difference between the non interacting group and the other 2 groups
Discussion

> Unexpectedly, compared with previous research (see Polllock et al., 2002), isolating elements in an initial stage about complex system didn't offer a better learning:
  - no difference in recall
  - inferior on transfer problems

> The non-interacting strategy induces a greater mental effort during the presentation of the second part (total interaction)

> Previous research has featured less complex material then:

  a more exposure of the various interaction may be needed to learn a very complex material?