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# Effect of the structuring of an instruction on the exploration and comprehension of a text : a dual oculometric and behavioural approach

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# Effect of the structuring of an instruction on the exploration and comprehension of a text : a dual oculometric and behavioural approach.

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# Darwinium, a serious game

## Objectives

To identify how the elements of the Darwinium game are perceived by young people and what effects the specificity of a set of instructions has on their understanding of the rules of the game.

# Context of the research

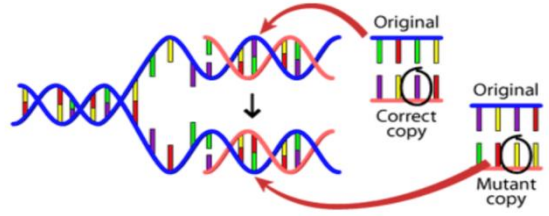
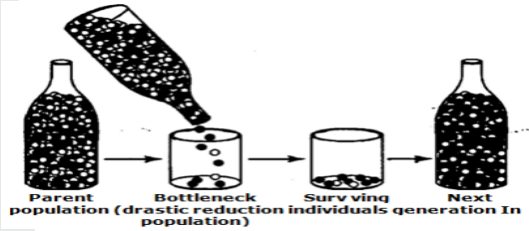
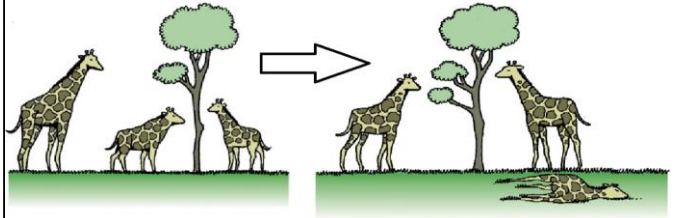
Randomness in ToE

Approaching randomness in ToE through an educational game

Darwinium game: Approaching randomness in ToE

# Randomness in ToE

Gayon, 2005 ; Merlin, 2013

Evolution mechanisms	Associated ideas of Randomness
<p><b>Genomic variation</b></p> 	<p><b>Chance</b></p> <p>Unintentional fortuitous event (not associated with any purpose)</p> <p>Associated with mutations and can sometimes give genetic innovations</p>
<p><b>Genetic drift</b></p> 	<p><b>Random probabilities</b></p> <p>Depending on the size of the biological population and the laws of probability. For a population to evolve, it is not necessarily related to adaptation, it may simply reflect the effect of random probability at any stage of reproduction (Jacob, 1981).</p>
<p><b>Natural selection</b></p> 	<p><b>Contingence</b></p> <p>Intersection of independent causal series: the presence of external factors and the internal variation of an organism</p> <p>Mechanism combining fortuitous events, that are contingent in a historical perspective</p>

# Approaching randomness in ToE through an educational game

- Randomness, intrinsically linked to gaming (Solinski, 2015)
- Games in education:
  - Allows to experiment with the right to make mistakes (Sanchez et Romero, 2020)
  - Engaging et motivating  
(Alvarez et al., 2016)
  - Allows access to the complexity of a concept
  - Must be efficient (Sanchez et Romero, 2020)

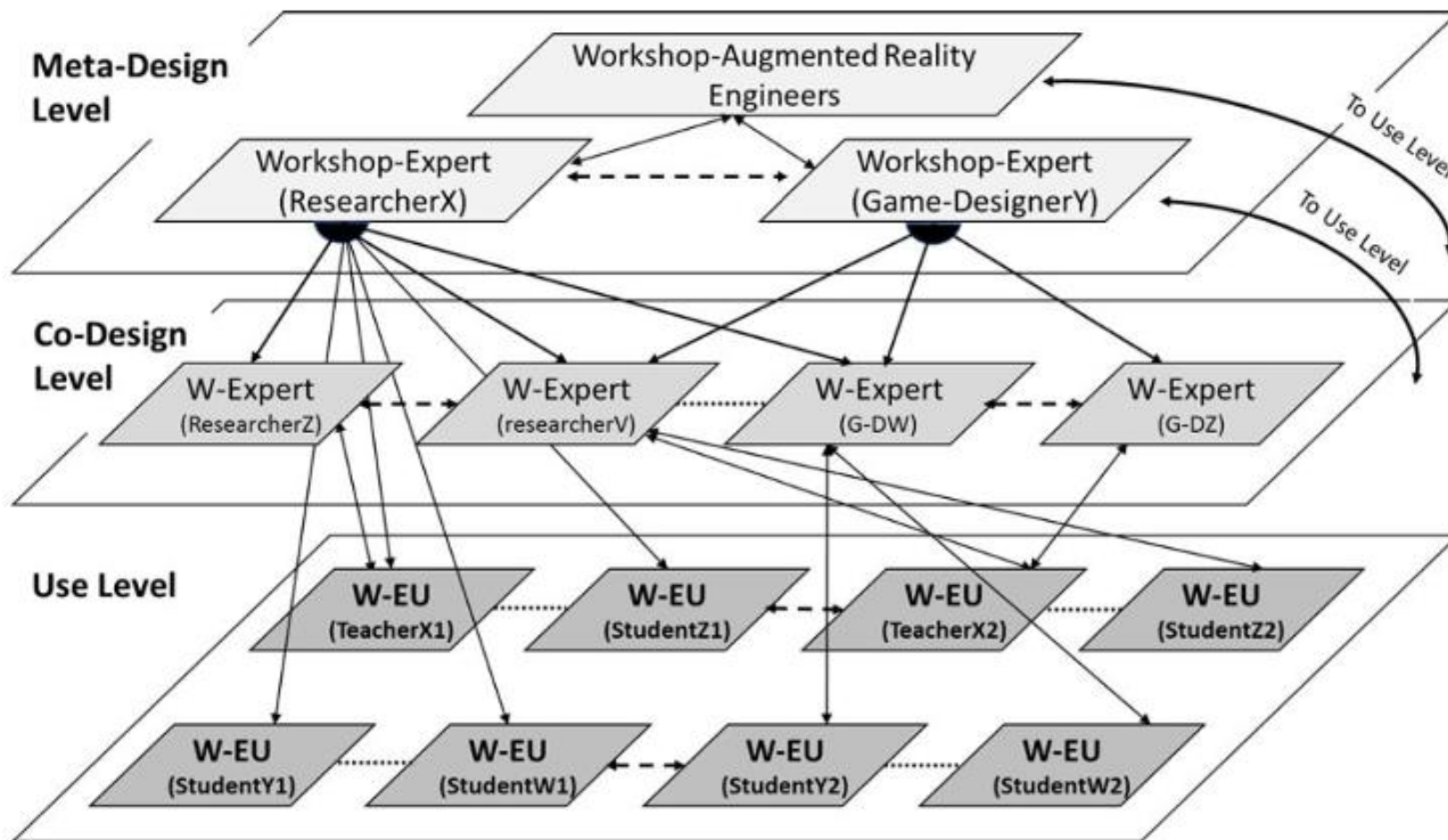
Du premier  
prototype



Au jeu de  
plateau tangible

# Metaconception process of the game « Darwinium »

(adapted Ardito *and al.*, 2015)



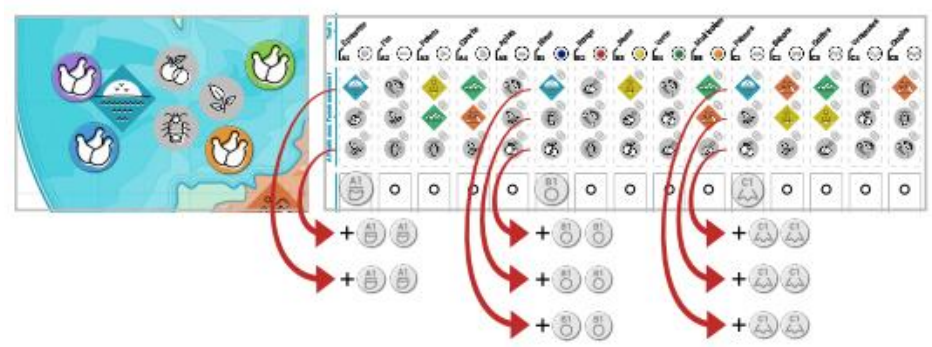


# Darwinium game: Approaching randomness in ToE

Random probability



Contingency



## Research question

How the elements of the Darwinium game are perceived by young people and what effects the specificity of a set of instructions has on their understanding of the rules of the game ?



# Methods

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Material

Response modalities

Design

Participants

Procedure

# Material

➤ 10 elements from the game (rules, board game and cards)



**Histoire du jeu**

La découverte d'une espèce d'animaux qui se reproduisent très rapidement a révolutionné le monde scientifique.

En tant que chercheur accidentellement connu, tu participes à un vaste programme de recherche grandeur nature.

Un dôme de plusieurs kilomètres de diamètre a été installé en milieu naturel pour te permettre de modifier et modifier les environnements dans lesquels vivent des populations de cette espèce.

Tu cherches à comprendre l'évolution de ta population et à augmenter ses chances de survie.

Noms et prénoms des joueurs:

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**Population de départ**

Observation



Prise de note

Population en mer: Environnement favorable à la reproduction des animaux possédant des épines, peau bleue et pattes palmées.

Population qui se reproduit vite mais peu de variation entre les individus. Ne savent pas si la population survit à des modifications d'environnement ??

A1 - Bec	B1 - Peau	C1 - Pattes
A2 - Bec	B2 - Peau	C2 - Pattes
A3 - Bec	B3 - Peau	C3 - Pattes
A4 - Bec	B4 - Peau	C4 - Pattes
A5 - Bec	B5 - Peau	C5 - Pattes

Proportions

Bec    Peau    Pattes



**DARWINIUM** Cartographie des environnements

**Légende**

**Types d'environnement**

- Mer
- Désert
- Forêt
- Montagne

**Ressources**

- Fruits
- Végétaux
- Insectes
- Matière organique morte
- Viande



**Pollution**



Lors de travaux, en creusant on découvre accidentellement une ancienne carrière de soufre. Cela provoque le dépôt d'une poussière jaune toxique à la surface des montagnes et des déserts. Les animaux à peau jaune et à peau multicolore se camouflent mieux et échappent davantage à leurs prédateurs. Pour les autres animaux, c'est plus difficile.

**En montagne et dans les déserts**, les joueurs qui ont des **jetons peau bleue (B1), rouge (B2) ou verte (B4)** en perdent 1 de chaque. Les joueurs qui ont des **jetons peau jaune (B3) ou multicolore (B5)** en gagnent 2 de chaque



# Response modalities

- Different modalities of responses (open question, forced choices, drag and drop items)

Cite une particularité associée aux caractéristiques des animaux mentionnée dans l'une des 3 cartes que tu viens d'observer.

Réponse du participant...

Suite

Coche les symboles qui correspondent aux traits de caractère de la population de départ.

- |  |  |   |
|--|--|---|
| <input type="checkbox"/> A1  A1 – Bec épuisette | <input type="checkbox"/> B1  B1 – Peau bleue  | <input type="checkbox"/> C1  C1 – Pattes palmées   |
| <input type="checkbox"/> A2  A2 – Bec fin       | <input type="checkbox"/> B2  B2 – Peau rouge  | <input type="checkbox"/> C2  C2 – Pattes sabots    |
| <input type="checkbox"/> A3  A3 – Bec pointu    | <input type="checkbox"/> B3  B3 – Peau jaune  | <input type="checkbox"/> C3  C3 – Pattes griffes   |
| <input type="checkbox"/> A4  A4 – Bec courbé    | <input type="checkbox"/> B4  B4 – Peau verte  | <input type="checkbox"/> C4  C4 – Pattes ventouses |
| <input type="checkbox"/> A5  A5 – Bec plat      | <input type="checkbox"/> B5  B5 – Peau orange | <input type="checkbox"/> C5  C5 – Pattes ongles    |

Suite

# Design

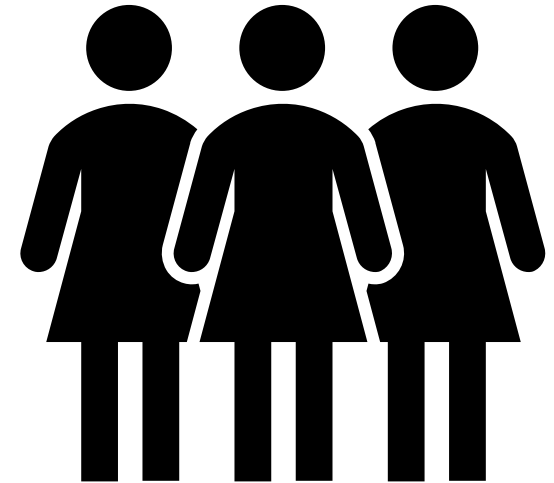
We choose a 2x1 design with 'Instruction' as 2-level factor ('detailed' / 'global')

**Detailed** : « Discover the story of the game presented in the image on the first page of the research booklet, then find out what characterises the starting population of animals. »

**Global** : « Explore the image on the first page of the research booklet, which tells the story of the game and describes the starting animal population. »

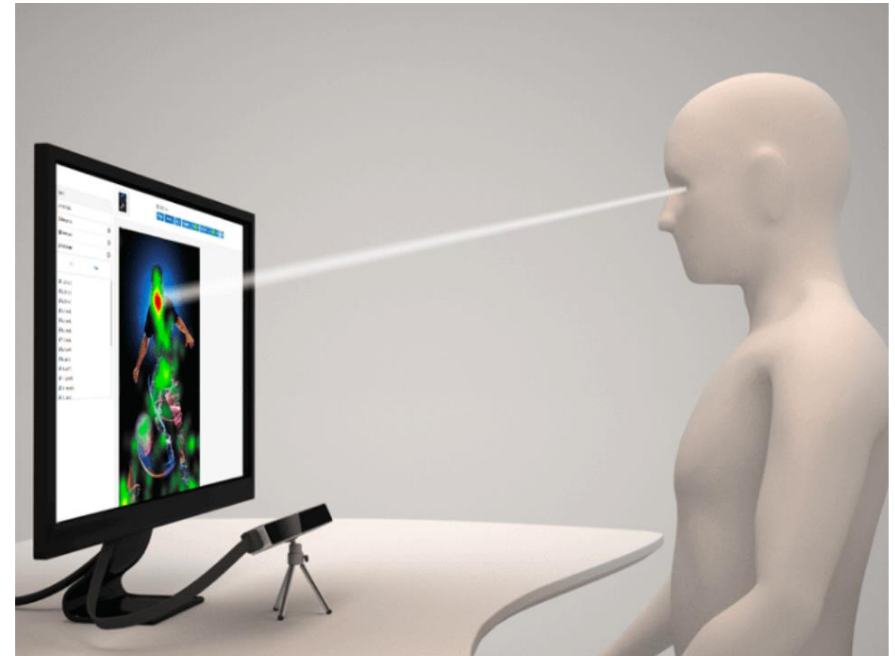
# Participant

- 8 volunteer student
  - naive to the purpose
  - 6 girls + 2 boys
  - from 14 to 25 y.o (M=21; SD = 3.9)
  - normal or corrected-to-normal vision



# Procedure

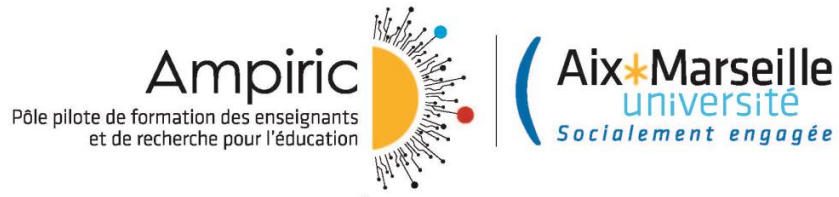
- Tobii Pro Fusion 250
- 27" screen
- at 144 Hz
- Webcam Logitech



Explore l'image du plateau central pour  
comparer les ressources qui se trouvent dans  
les mêmes types d'environnement.



Appuis sur la touche ESPACE quand tu as fini !



# Results

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Comprehension (accuracy & response time)  
Eye tracking (heatmaps)

## Comprehension (accuracy & response time)

Accuracy (%)	Mean	SD
Instruction +	<b>70.79</b>	38.77
Instruction -	<b>70.31</b>	32.55

RT (s)	Mean	SD
Instruction +	<b>60.21</b>	14.46
Instruction -	<b>63.14</b>	35.65

# Eye tracking (heatmaps)



Detailed  
instruction

# Eye tracking (heatmaps)



Global instruction

# Eye tracking (heatmaps)

## Detailed instruction

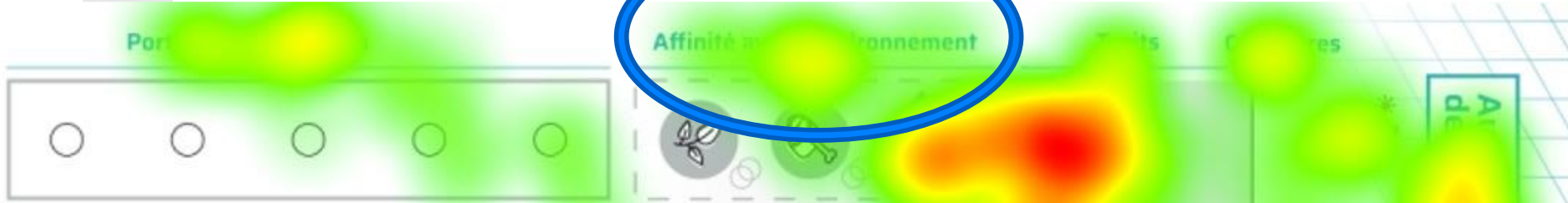


## Global instruction



# Eye tracking (heatmaps)

Detailed instruction



Global instruction



# Eye tracking (heatmaps)

Detailed instruction



Global instruction



# Eye tracking (heatmaps)

## Detailed instruction



## Global instruction





# Conclusion

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In conclusion  
Perspectives

Recherche en éducation

**COLLOQUE INTERNATIONAL** 4 au 6 octobre 2023

en hommage à JACQUES GINESTIÉ

## Conclusion



Detailed instructions seem to allow children to access faster to the information.



However, the accuracy seems to be equal in both cases.



The game's elements seem to be self-sufficient for pupils to play but teachers can improve the experience with focused instructions.

# Perspective

- To continue “proof of concept” by improving the design and the population