

Influence of a board-game narrative framework on student's writing in the context of evolution teaching

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Darwinium, a serious game

Main objective

To study how a board-game narrative framework influences students (13-14 years old) writings after a play activity about evolution.

Context of the research

An updated Theory of Evolution (ToE)

Randomness in ToE

Darwinium game: Approaching randomness in ToE

Discourses analysis : three types of discourses

An updated theory of evolution

(Barberousse, 2011, p. 369)

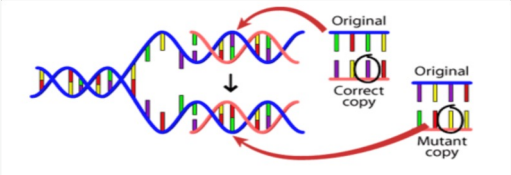
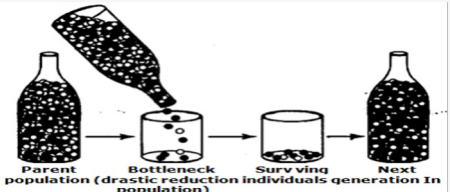
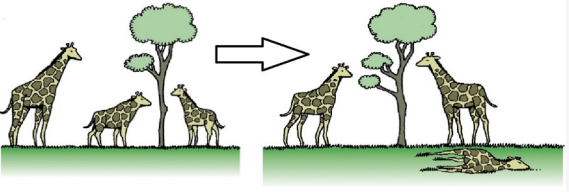
"Schematically, we can say that the theory of evolution takes as its starting point the fact that organisms can **reproduce**, and that the offspring of these **reproductive events can differ** from their parents.

On the other hand, each organism has a limited existence in space and time. Evolutionary theory tells us that, in this context, the structure of the genealogical network depends on **the processes of random selection (drift)** and **selective selection (natural selection)** that act on organisms in each generation.

The action of these two processes is determined both by the **intrinsic characteristics** of organisms and by the **spatio-temporal context** in which they find themselves."

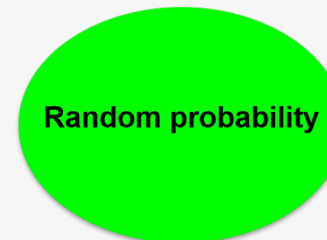
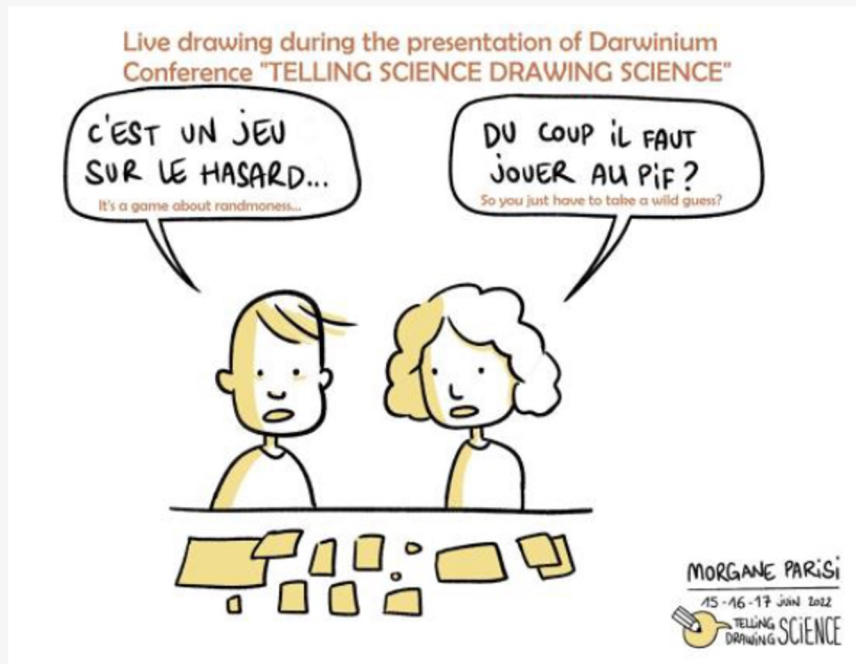
Randomness in ToE

Gayon, 2005 ; Merlin, 2013

Evolution mechanisms	Associated ideas of Randomness
<p>Genomic variation</p> 	<p>Chance Unintentional fortuitous event (not associated with any purpose) Associated with mutations and can sometimes give genetic innovations</p>
<p>Genetic drift</p> 	<p>Random probabilities 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>Natural selection</p> 	<p>Contingency Intersection of independent causal series: the presence of external factors and the internal variation of an organism Mechanism combining fortuitous events, that are contingent in a historical perspective</p>



Darwinium game: Approaching randomness in ToE



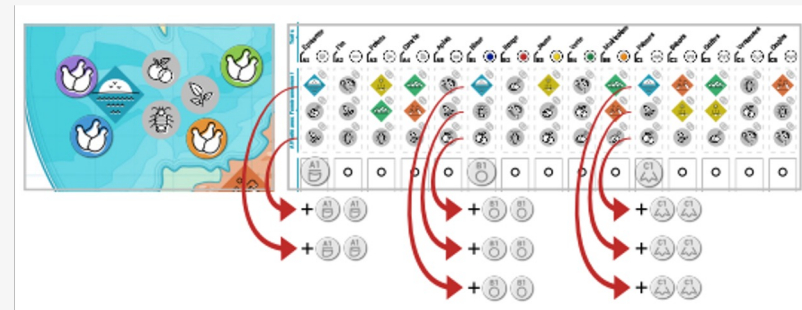


Darwinium game: Approaching randomness in ToE

Random probability



Contingency



Darwinium game as a narrative framework

Playing rules and
constraints

Game mechanics
and facts



A NARRATIVE
FRAMEWORK

Narrative frameworks :

- are a way of thinking (Bruner, 2002 ; Gould, 1989) and organizing knowledge (Echterhoff & Straub, 2003 ; Dessart & Triquet, 2015 ; Dessart, 2021).
- allow learners to engage in a work of scientific problematization (Lhoste et al, 2012; Bruguière et Orange-Ravachol, 2023) and allow the expression of creativity (Zabel, Bruguière, Paulin & Zdunek, 2021).

Research question

To what extent does the narrative framework of the darwinium game influence students' explanations on evolutionary process after a play activity ?

Methods

Data collection

- Data collected during a debriefing session after a game session of "Darwinium"
- 57 students (14-15 years old)
- 8 games were played in parallel (4 or 3 teams of 2 players)



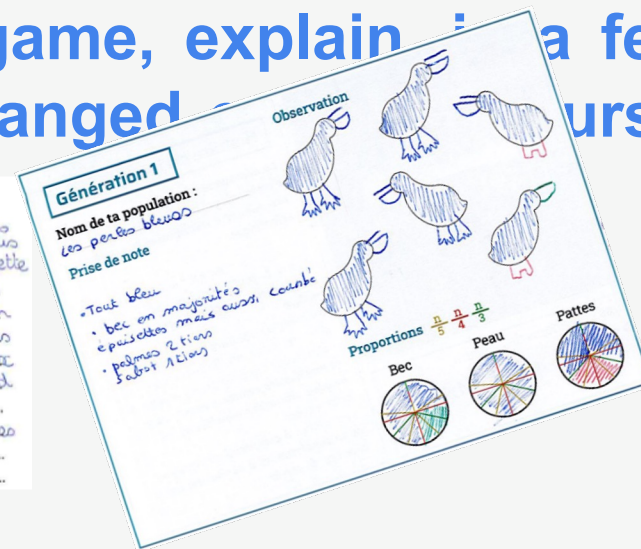
Data collection

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TASK: Using the elements of the game, explain in a few lines, how your animal population has changed during the course of the game.

A partir des éléments du jeu, expliquer, en quelques lignes, comment votre population d'animaux a évolué au cours des tours de jeu.

du cours des tours du jeu, ma population a évolué car le plus de caractéristiques de la population au départ ont été éliminées et des autres caractéristiques ont été ajoutées. Par la suite, quand on a joué, on a dû se rendre compte que les animaux qui avaient des caractéristiques qui leur ont permis de survivre ont été reproduits et cela a créé de nouveaux individus dans la population. Plus que par la suite, quand on a joué, on a dû se rendre compte que les animaux qui avaient des caractéristiques qui leur ont permis de survivre ont été reproduits et cela a créé de nouveaux individus dans la population.



Evolution : *a priori* analysis grid

(Barberousse, 2011)

Typology	Epistemological indicators
Evolutionniste	Texts describe population changes in terms of evolution.
Finalist	Texts describe evolutionary changes as voluntary to adapt to the environment
Fixist	Texts talk about populations that don't change.
Populational thinking	Texts refer to different individuals in the population monitored.

Evolution : *a priori* analysis grid

(Barberousse, 2011)

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“Our population has evolved over the course of the game”

Evolution : *a priori* analysis grid

(Barberousse, 2011)

Typology	Indicators
Evolutionniste	Texts describe population changes in terms of evolution.
Finalist	Texts describe population changes in terms of evolution. "Our population has been forced to adapt"
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Randomness : *a priori* analysis grid

(Coupaud, Gobert, Castéra & Delsegeries, 2024)

Category	Epistemologics indicators
Random probabilities	A random event obeys a law of probability.
Contingency	A contingent event occurs in a theoretical field of possibilities, following the encounter of two random and independent series of events.
Ignorance	The result of man's ignorance of phenomena that are too complex.
Destiny	The result of divine intervention. Randomness does not exist.

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Discourses : inductive analysis grid

Category	Textuals indicators
Description	Texts describe the population at each generation in terms of the distribution of characteristics
Narrative	Texts tell a story organised according to a structure beginning-middle-end ; Texts consider people as characters who have actions to perform ; chronology of the game
Explanatory	Texts explain the reasons why populations have changed from one generation to the next

Results

Acceptance and understanding of evolution

		Total (/56 texts)
Evolutionnist	Present	54
Finalism	Present	22
Fixist	Present	0
Population thinking	Present	47
	Consitent	18
Randomness	Random probabilities	23
	Contingency	6
	No possible	0
	Destiny	0
Nature of discourse	Descriptive	42
	Narrative	39
	Explanatory	28

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Partial overall results		Total (/56 texts)
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A single type of discourse		11
Combination of discourses (45/56)	Descriptive + Narrative	18
	Descriptive + Explanatory	9
	Narrative + Explanatory	9
	Descriptive + Narrative + Explanatory	9

An example: combination **descriptive** and **narrative** discourses

A partir des éléments du jeu, expliquer, en quelques lignes, comment votre population d'animaux a évolué au cours des tours de jeu.

à début notre espèce avait des pattes palmées, des mains palmées et couleur bleu et une épuisette.
Lors de la première tour après avoir dessiné de nouveaux caractères notre population avait des pattes à ongles, des pattes palmées, des mains palmées et une épuisette et un équipement de plongée.
Enfin au dernier tour on a eu la capacité de camouflage et camouflage de nos animaux multicolores, des pattes à ongles et toujours l'équipement on peut être notre population aurait pu envisager une évolution sur terre.

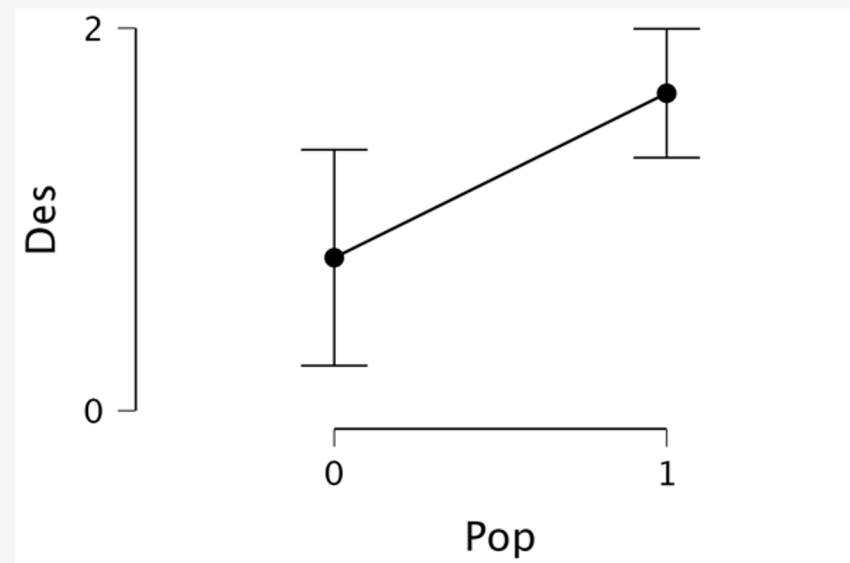
At the beginning, our species had webbed feet, webbed hands, blue colour and a landing net beak. **In the first round**, after sorting and drawing new characters, our population had nail feet, webbed feet, webbed hands, blue colour and a landing net beak. Our population was still in the sea, but affected by an epidemic. **Then, in the last round**, we had the ability to camouflage ourselves (become multicoloured), **nail legs and still the sea equipment**, perhaps our population could have considered evolving on land.

Relationship between evolutionary concepts and discourse's nature

- Descriptive discours

	No population	Population
N	9	47
Moyenne	0,8	1,66
Ecart type	0,79	1,15

Significant difference
(P value U Mann-Whitney : 0,029)

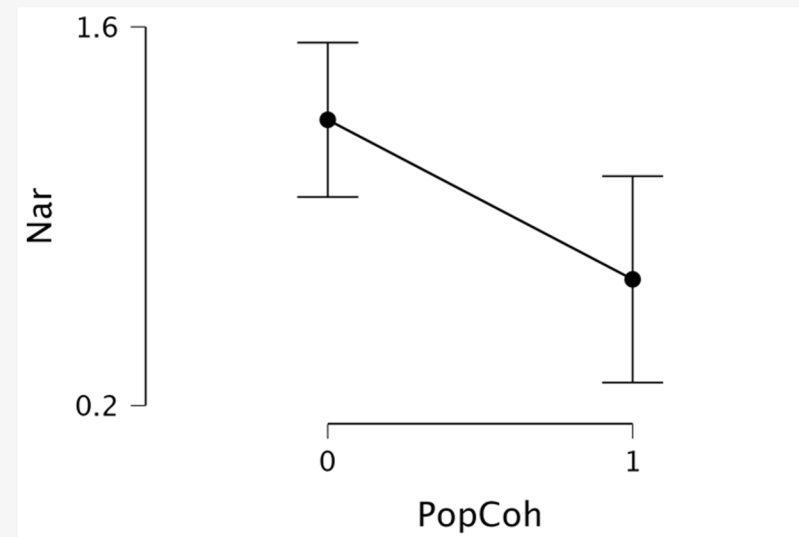


Relationship between evolutionary concepts and discourse's nature

- Narrative discourse

	No consitent population thinking	Consitent population thinking
N	38	18
Moyenne	1,26	0,67
Ecart type	0,88	0,77

Significant difference
(P value U Mann-Whitney : 0,020)



Relationship between evolutionary concepts and discourse's nature

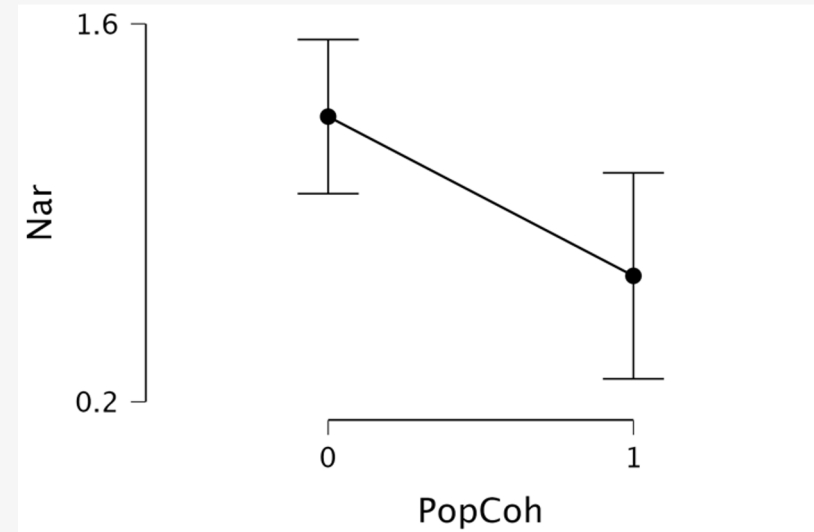
- Narrative discourse

Code d'anonymat : E71ANE

A partir des éléments du jeu, expliquer, en quelques lignes, comment votre population d'animaux a évolué au cours des tours de jeu.

De notre population de départ à la 1^{ère} génération, je peux observer que les caractères des bêtes dans la forêt sont plus liés à l'environnement de la forêt. Mais le hasard lors de la reproduction au niveau de la génétique a fait apparaître des nouveaux caractères comme les points et les queues qui ne sont pourtant pas adaptés à l'environnement.

De la 1^{ère} à la 2^{ème} génération, nous avons déplacé notre population dans la forêt ce qui a fait changer la population pour s'adapter à l'environnement mais la génétique a aussi agi en faisant apparaître de nouveaux caractères.



Significant difference (P value U Mann-Whitney : 0,020)

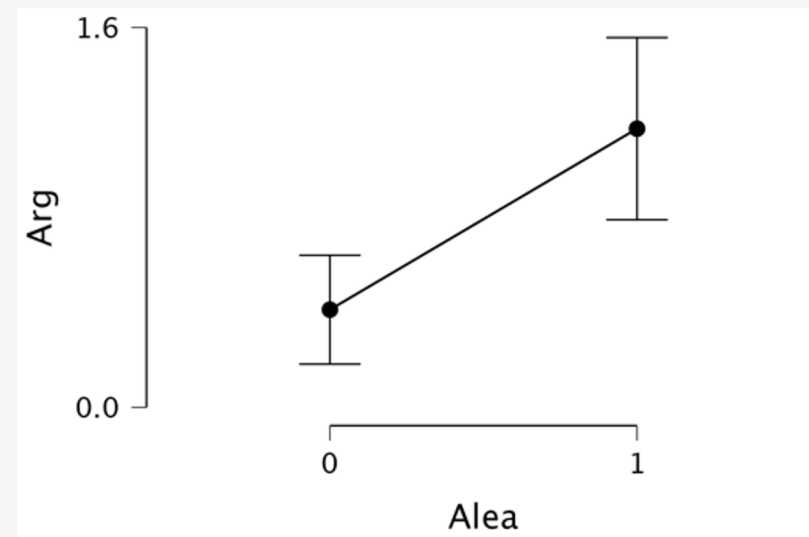
From generation 1 to 2, we have moved our population to the forest, which has caused the population to change to adapt to the environment, but genetics has also acted to bring out new traits.

Relationship between evolutionary concepts and discourse's nature

- Explanatory discourse

	No Random probabilities	Random probabilities
N	33	23
Moyenne	0,41	1,17
Ecart type	0,66	0,89

Significant différence
(P value U Mann-Whitney < 0,01)



In conclusion

Conclusion and perspectives

1. Narrative framework of the game engages the pupils in evolutionary thinking, but the idea of contingency still seems difficult for them.
2. By mobilising the concepts of evolution (chance, etc.), the game's narrative imagination brings them together in a still « naïve syncretism ».
3. We believe that this imaginary narrative is the strength of the game that should be explored further in the classroom (text, oral discourse, etc.).
4. Measuring the effectiveness of the game in learning ToE through a quantitative analysis based on concept inventory

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