



LIUM

Laboratoire d'Informatique
Le Mans Université

CSEU 2023

15TH INTERNATIONAL CONFERENCE ON COMPUTER SUPPORTED EDUCATION

Mapping Task Types and Gameplay Categories in the Context of Declarative Knowledge Training

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Outline

1

Research context

objectives & challenges

2

Previous work

game & training elements

3

Our Research question

how to map?

4

Proposition

a mapping approach


5

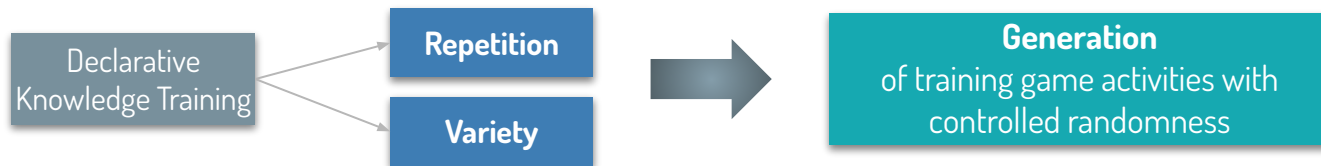
Modeling & Partial evaluation

6

Limitations & Conclusion

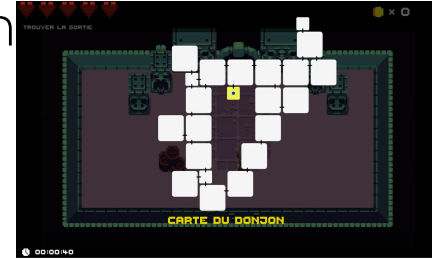
Research Context

- Declarative Knowledge Training through Games 
 - training = providing learners with different forms of questions repeatedly (*retrieval practice*)
 - requires repetition ⇒ need for variety
- How to design training game activities for declarative knowledge ?



Research Context & Overall Objective


- Roguelites are dungeon-like games based on
 - procedural generation with randomness (variety)
 - permadeath (repetitive game mechanic)
 - progress (limited retention of elements)



- *Roguelites for declarative knowledge training ?*
 - A training game activity = dungeon, interconnected rooms in which the training takes place

How to design and implement Roguelite-oriented training activity generators ?

Research Challenges

1. Defining elements from both perspectives
 - *game elements*
 - *training elements*
 2. Identifying relations between the elements
 3. Specifying these relations as machine-readable
 - *for the generation algorithm*
- 

Training elements

- Exploratory Research in the context of the AdapTABLES project (Laforcade et al., 2022)
 - multiplication tables training
 - user group of 2nd to 6th grade mathematics teachers and experts
- Lead to the definition of training tasks
 - *“complete a fact with missing result”, “decide if a fact is correct”*



Training elements: Task Types

- Abstraction of these tasks into types for a genericity purpose

Completion 1	Completion 2	Reconstruction	Identification	(Non-)Membership Identification
Complete an incomplete fact that has one missing element	Complete an incomplete fact that has two missing elements	Replace, in the correct order, all important elements of a fact	Identify the correctness or incorrectness of one or several facts	Identify elements that share or do not share a given property
$3 \times ? = 15$ $15 = ? \times 5$ $3 \times 5 = ?$	$? \times ? = 15$ -- [3, 6, 5, 10] $? \times 5 = ?$ -- [3, 6, 5, 15, 8] $3 \times ? = ?$ -- [3, 5, 15, 8]	$? \times ? = ?$ [3, 6, 5, 10, 15]	$3 \times 5 = 15$ -- <input checked="" type="checkbox"/> or <input checked="" type="checkbox"/> $6 \times 6 = 35$ -- <input checked="" type="checkbox"/> or <input checked="" type="checkbox"/>	[3, 5, 9, 12, 14, 21] which are results of the table 3?


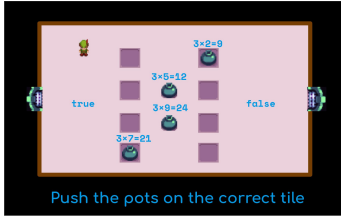

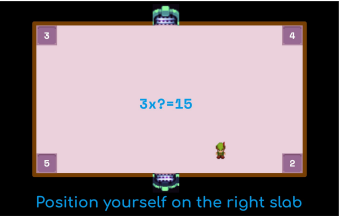
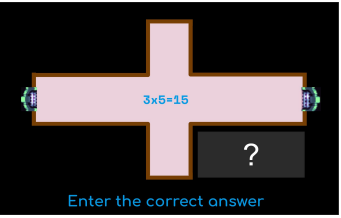
Game elements

“Although learning games can fail as real games in many ways, the failure happens mostly commonly in their lack of gameplay — the fun things that the player gets to decide, control, and do.” (Prensky, 2005)

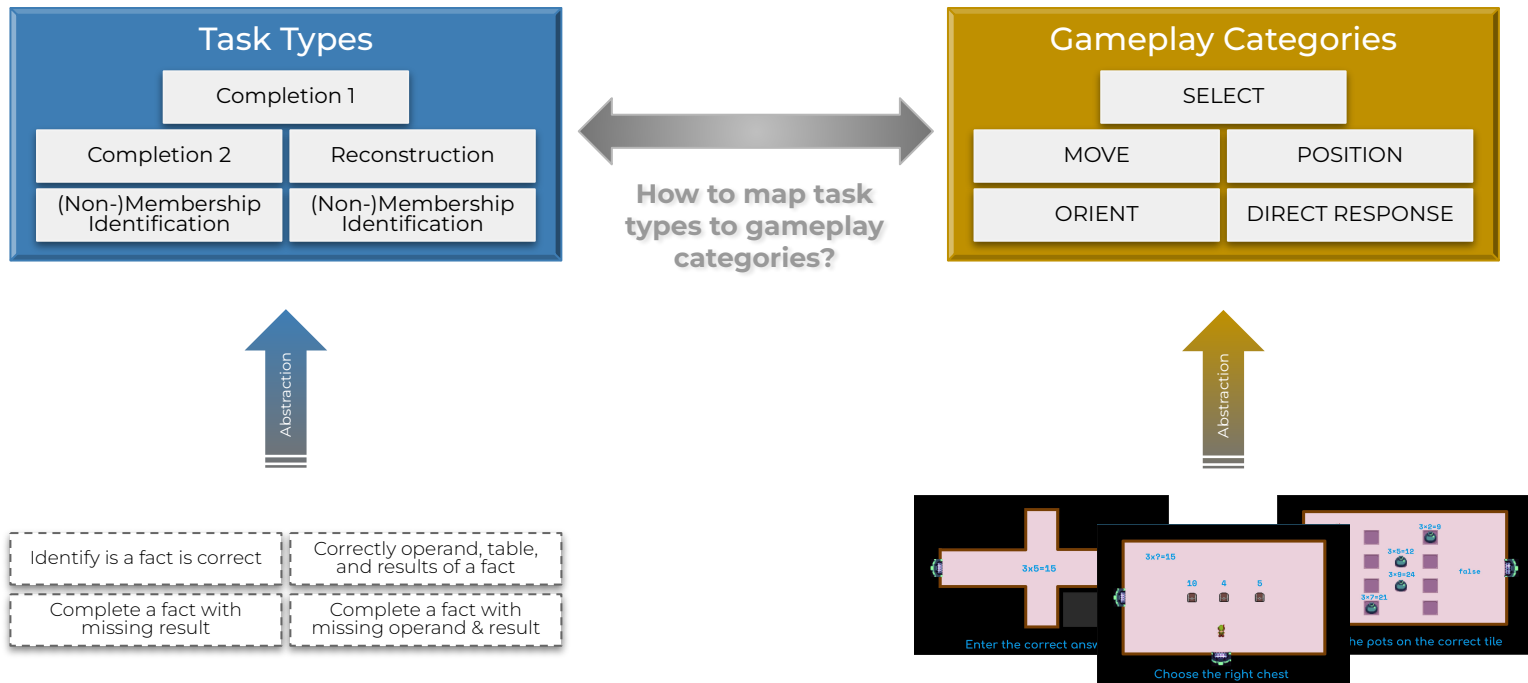
- Informal interviews with game designers
 - design of a variety of gameplay mock-ups by task types
- Observation : some gameplay seemed to belong to the same category
 - coherent with (Djaouti et al., 2005)’s game classification

Game elements: Gameplay Categories

- Definition of gameplay categories for Roguelite Training Games

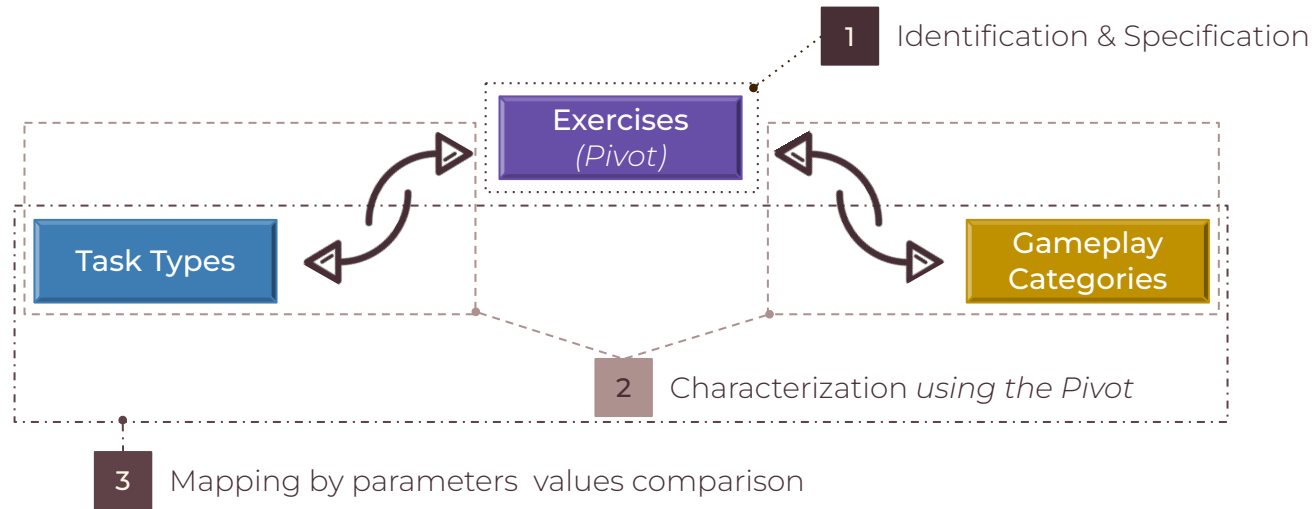
SELECT	MOVE	ORIENT	POSITION	DIRECT RESPONSE
Select (e.g., touch, kill, break, open) objects wearing the correct answers, through avatar actions	Correctly place objects at specific locations through avatar actions	Orient objects (e.g., rotate), through avatar actions, towards the correct answer	Move/Place the avatar to the necessary positions for choosing or typing the correct answer	No action is required through the avatar, learners type down their answer using an input device (e.g., keyboard)
 <p>Choose the right chest</p>	 <p>Push the pots on the correct tile</p>	 <p>Orient the statue</p>	 <p>Position yourself on the right slab</p>	 <p>Enter the correct answer</p>

Research Question

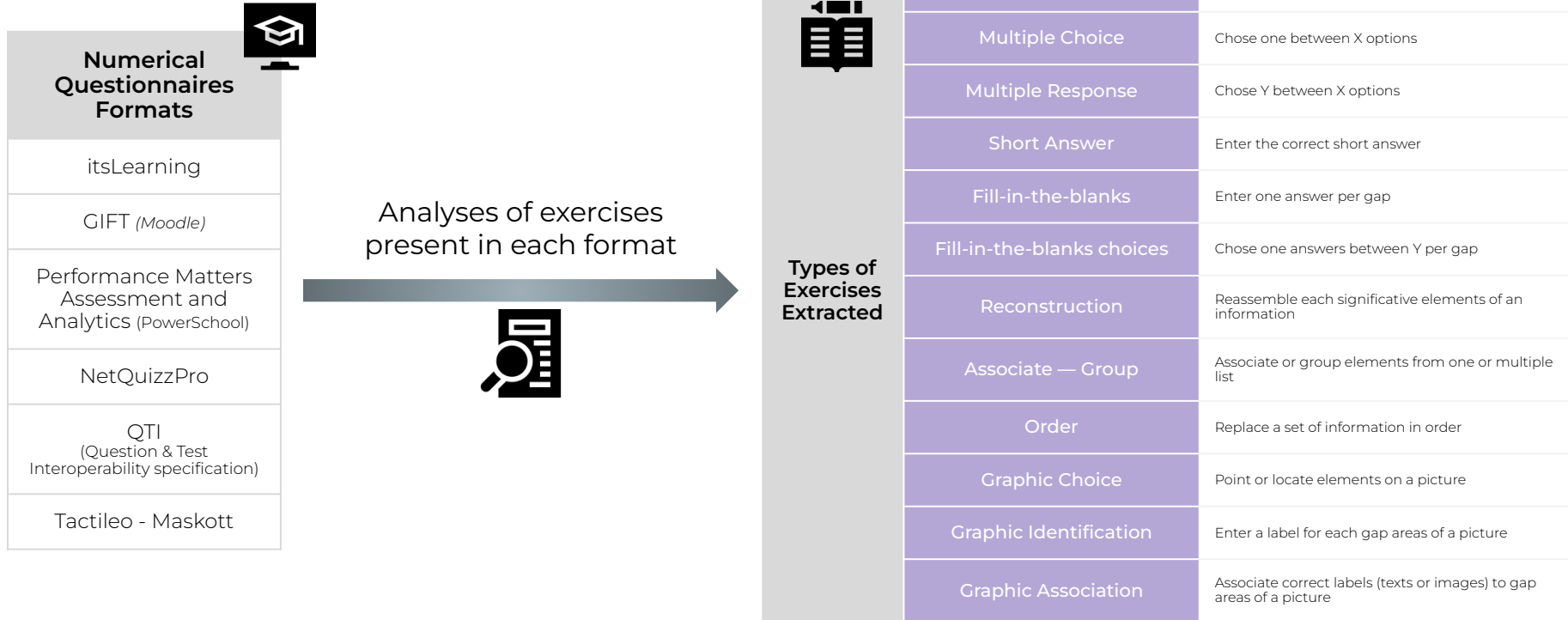


Proposition & Method

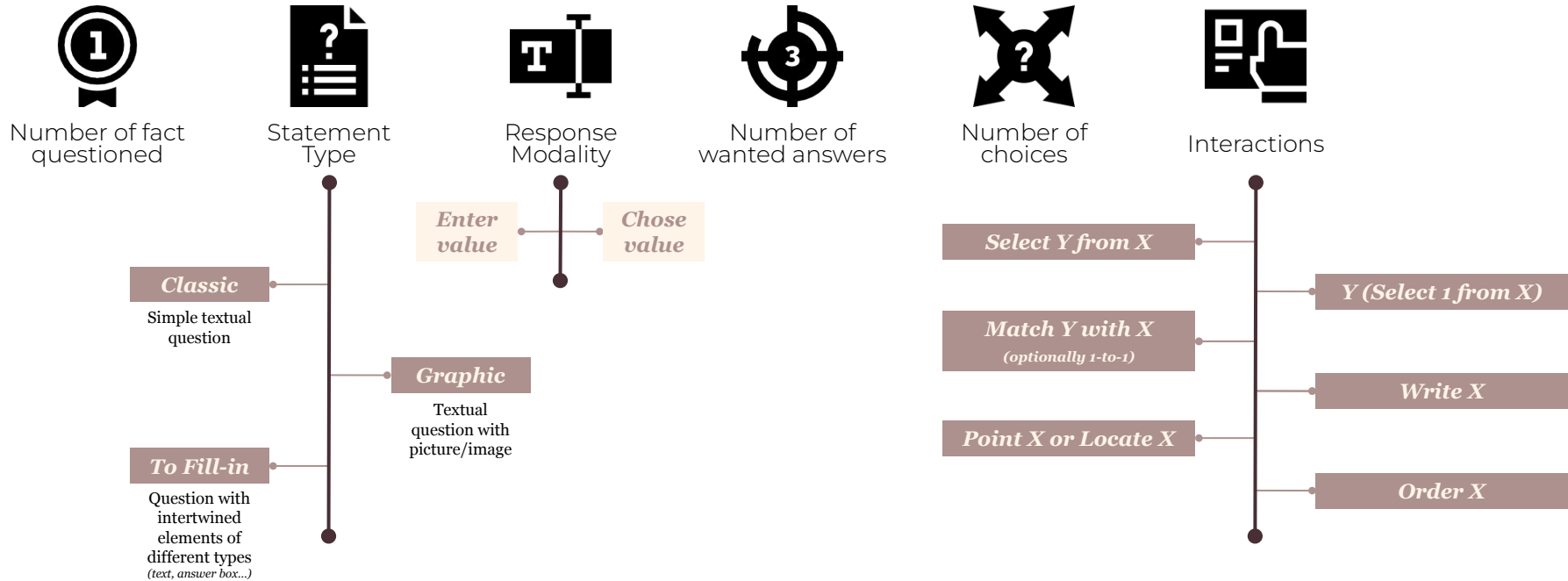
- Using numerical questionnaire formats exercises as a pivot to define a systematic mapping approach








1.a. Identification of the Pivot *(intermediary element)*



1.b. Pivot Identified Parameters



2.a. Task Types Characterization

					
Completion 1	1	Classic Graphic To Fill-In	Input Choice	1	0 2 to ∞
Completion 2	1	Classic Graphic To Fill-In	Choice	2	2 to ∞
...









Values association is not easy !

Example : $? \times ? = 12$ with *Input*.
But is it 3×4 , 6×2 , 1×12 ?







2.a. Task Types Characterization

					
Completion 1	1	Classic Graphic To Fill-In	Input Choice	1	0 2 to ∞

						
Short Answer	1	Classic	Input	1	0	Write 1

Values Comparison by Pair

⇒







						
Completion 1	1	Classic Graphic To Fill-In	Input Choice	1	0 2 to ∞	Write 1

2.b. Gameplay Categories Characterization







						
MOVE	1 to ∞	Classic Graphic To Fill-in	Choice	1 to ∞	2 to ∞	Select 1 from X Point 1 / Locate 1 Match 1 with 1 Match Y with X Point Y / Locate Y Select Y from X Y (Select 1 from X ₁ to X _n)

} **Same Parameters as Exercises**

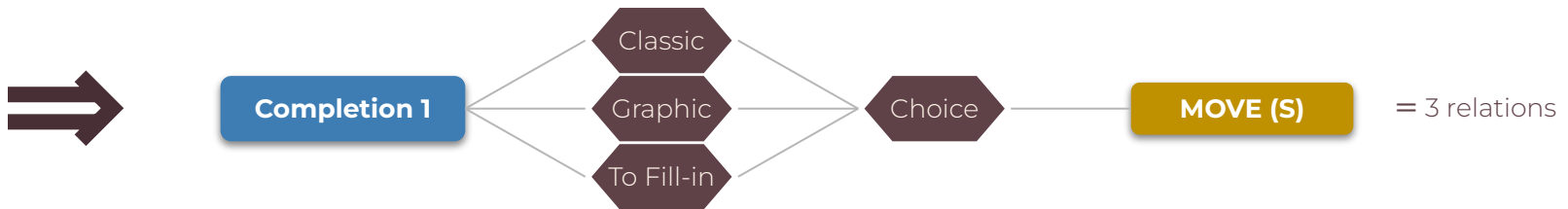
- We observed that the  and  changed depending on 

						
MOVE (S)	1	Classic Graphic To Fill-in	Choice	1	2 to ∞	Select 1 from X Point 1 / Locate 1 Match 1 with 1
MOVE (M)	1 to ∞	Classic Graphic To Fill-in	Choice	2 to ∞	2 to ∞	Match Y with X Point Y / Locate Y Select Y from X Y (Select 1 from X ₁ to X _n)

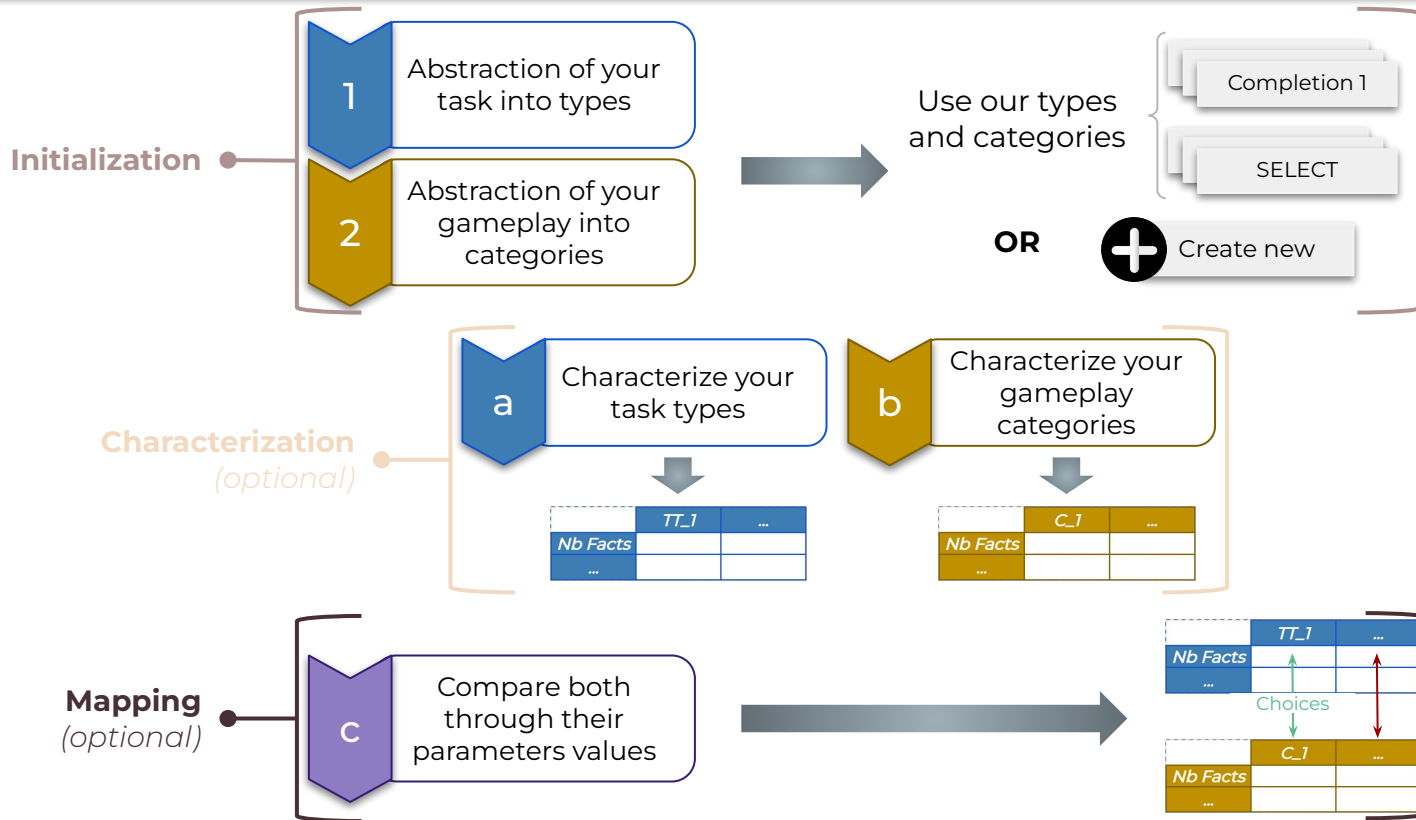
3. Mapping Through Parameters

						
Completion 1	1	Classic Graphic To Fill-In	Input Choice	1	0 2 to ∞	Write 1
MOVE (S)	1	Classic Graphic To Fill-in	Choice	1	2 to ∞	Select 1 from X Point 1/ Locate 1 Match 1 with 1
MOVE (M)	1 to ∞	Classic Graphic To Fill-in	Choice	2 to ∞	2 to ∞	Match Y with X Point Y/ Locate Y Select Y from X Y (Select 1 from X ₁ to X _y)

Values Comparison by Pair

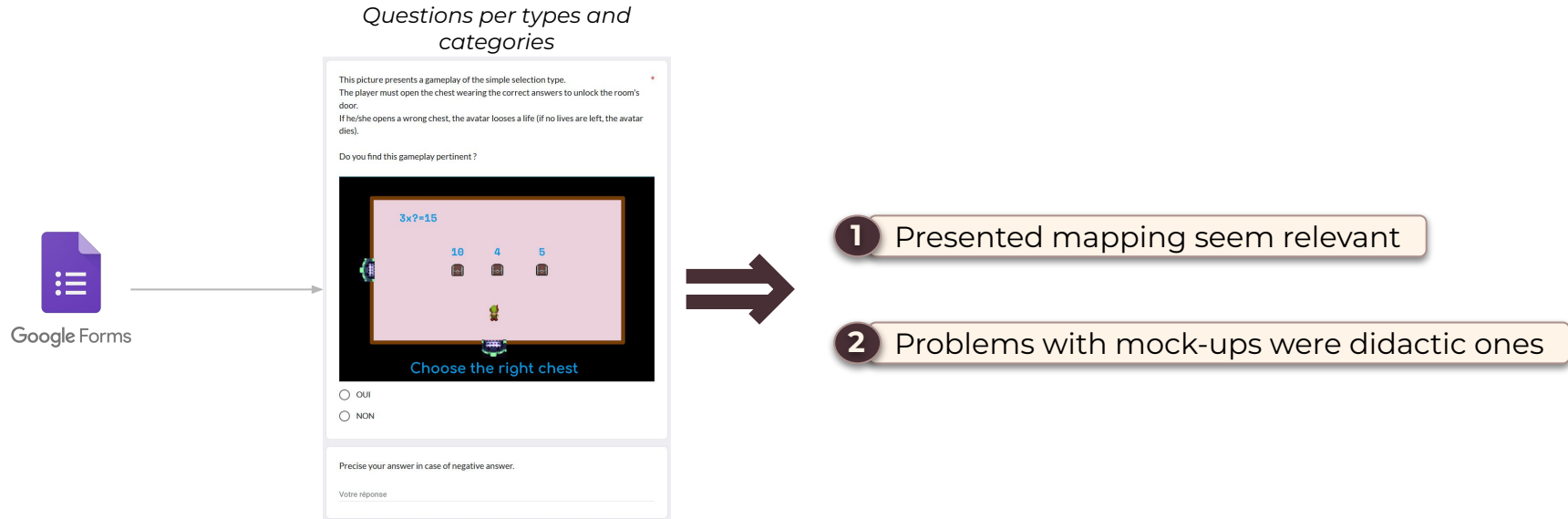


Proposed Systematic Mapping Approach



Partial Validation

- Feedback gathering on gameplay mock-ups with user group members



Limitations

- Task types are abstracted from one domain only
 - do not cover every exercise (*Order*)
- Task Types and Game Categories are not exhaustive
 - could be refined depending on other domains, viewpoints...
 - subjective parameters
- All “Graphic” relations were not tested
 - unused for multiplication tables training

Conclusion & Perspective

- **Contribution** : A mapping approach of didactic tasks to abstract gameplays
 - including mapping relations between our defined task types and gameplay categories
- **Limit** : the proposed types and categories are not exhaustive
 - need to be refined to gain in genericity
- **Perspective** : use of another domain to expend task types (ongoing)
 - historical and geographical declarative knowledge



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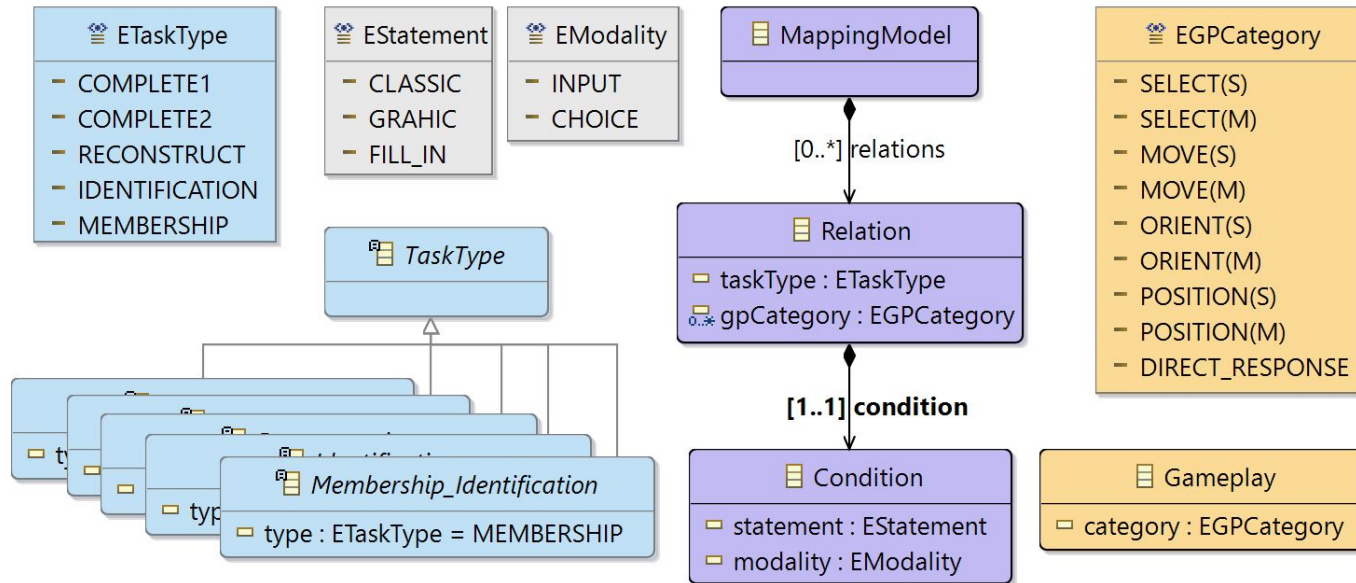
Contact us for in-depth discussions



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Mapping Modeling

- Generator of Roguelite Training Activities
 - using Model Driven Engineering tools (Kent, 2002)



Resulting relations

