

# A Card-based Design Tool for Designing Tangible Learning Games

We present our preliminary research intended to explore the potential of a card-based design tool for designing tangible learning games called TLG cards. TLG cards aim at making theoretical knowledge about designing tangible learning games accessible and usable to designers during their design practice.

## Motivation

Tangible user interfaces (TUIs) have been suggested to be beneficial to learning by many researchers. Such claimed benefits include they facilitate exploration, reflection, and collaboration; they bootstrap learning of abstract concepts; and they support collaborative learning. Meanwhile, there has been increasing interest in investigating educational games that can successfully synthesize educational content with play mechanics, as such games are intrinsically engaging and rewarding, and can help learners develop multimodal literacies as well as skills of collaboration, creativity, communication, and critical thinking.

We propose that tangible learning games, which combine the strength of TUIs and games, should have great potential in support learning. In this preliminary research, we distill design guidelines for tangible learning games from existing theories and empirical work. Furthermore, to make these design guidelines accessible and usable to designers during their design process, we translate these design guidelines into a card-based design tool: tangible learning game (TLG) cards.

## Research Questions

- Are cards an effective design tool in making design theories about tangible learning games more accessible and usable in design practice?
- How do designers use the cards in different design activities?
- How do specific characteristics of the cards (e.g., presentation, form, content) enable or limit such use?

## Design Research Methodology

### 1 Prototype Design

Distill design guidelines for tangible learning games from relevant theories and empirical findings (such as [1][5]) and translate them into TLG cards.

### 2 Expert Review

Ask experts to review the cards to ensure the quality of the research instrument of TLG cards.

### 3 Design-in-Use Study

Conduct design-in-use study to explore effectiveness of cards, how designers use the cards in different design activities, and how specific characteristics of the cards enable or limit such use.

## Preliminary Card Design

The diagram illustrates the structure of a Tangible Learning Game Card, divided into five numbered sections:

- 1. Header:** Interaction Learning Game Collaboration
- 2. Design Guideline:** Using spatial, physical, temporal or relational properties of tangible interface can slow down interaction and trigger reflection. Both direction interaction with the world (stepping-in) and reflection (stepping-out) are important to knowledge construction.
- 3. Some TUI design strategies to trigger reflection:**
  - Requiring learners to move locations to complete an activity
  - Slowing down the interaction through the physical size of input space or physical objects
  - Temporarily pausing the system as a response to input actions
  - Pairing familiar input actions with unexpected output responses
- 4. Examples:**
  - Towards Utopia:** children have to suspend their stamping activity with the Interactive Map Station and take the stamp over to the Information Station to trigger an informational narrative.
  - Futura:** world events such as mud slide pauses players' fast interactions with the system and provide content to trigger reflection.
- 5. QR code:** Links to the web page for each card, which contains detailed information about related theory, concepts, and other examples.

- 1. Four elements (interaction, learning, game, and collaboration) we consider important to designers of tangible learning games:** Cards are coded by these four categories, so that designers may sort and compare the cards when they want to focus on a specific element of tangible learning game design.
- 2. Design guidelines:** Are written in language familiar to designers to ensure that they are usable and practical. Dense theories are hidden.
- 3. Explanation about the design guideline and examples from design practice:** To facilitate interpretation of the design guideline.
- 4. Two examples demonstrating the design guideline:** To improve understanding and inspire new designs.
- 5. QR code:** Links to the web page for each card, which contains detailed information about related theory, concepts, and other examples.

## Key References

- [1] Antle, A. N. and Wise, A. F. Getting down to details: Using theories of cognition and learning to inform tangible user interface design. *Interacting with Computers* (accepted). Draft available at <http://www.antle.iat.sfu.ca/publications.php>
- [2] Bekker, T. and Antle, A.N. 2011. Developmentally situated design (DSD): making theoretical knowledge accessible to designers of children's technology. *Proceedings of the 2011 annual conference on Human factors in computing systems* (New York, NY, USA, 2011), 2531–2540.
- [3] Hornecker, E. 2010. Creative idea exploration within the structure of a guiding framework: the card brainstorming game. *Proceedings of the fourth international conference on Tangible, embedded, and embodied interaction* (Cambridge, Massachusetts, USA, 2010), 101–108.
- [4] Jenson, J. 2011. Exploring "Content-free" Educational Game Design <http://www.ludicjunk.com/digitl/exploring-content-free-educational-game-design/>
- [5] Linehan, C. et al. 2011. Practical, appropriate, empirically-validated guidelines for designing educational games. *Proceedings of the 2011 annual conference on Human factors in computing systems* (New York, NY, USA, 2011), 1979–1988.