Frictional Patterns in the Design of Games for Learning

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Abstract: This work presents a case study of a game-based learning prototype to define *frictional design patterns* – design decisions that knowingly impede some specific user interaction – as a type of pattern to support learning with games. We evaluate frictional design patterns by applying the concept to a game focused on scientific argumentation in order to examine the balance between data collection requirements and players' access to information required for certain in-game epistemic performances.

In this paper, we advance the concept of *frictional design patterns*. A pattern in general is a reusable solution to a common design problem, whereas a frictional one, as we define it here, is one that knowingly and necessarily makes some specific user interaction more cumbersome. Frictional patterns may be seen as one way to design desirable difficulties – challenging circumstances that "trigger encoding and retrieval processes that support learning…" (Bjork & Bjork, 2011, p. 58). The goal of using frictional patterns is to explicitly document design decisions made to facilitate or detect learning outcomes, yet which also negatively impact users' experiences in some way, ideally so these impacts can be mitigated elsewhere or accounted for in analyses of players' behavior.

Defining frictional patterns

Many fields of design, such as software and interaction design, distinguish between design principles and design patterns to communicate different forms of design knowledge (Gamma, Helm, Johnson, & Vlissides, 1995). In this scheme, *principles* are abstract rules presumed to be useful across most contexts. *Patterns*, on the other hand are reusable solutions to frequent, concrete design problems (e.g., creating an adapter to let two ordinarily incompatible components interface with one another). Respectively, designers may also refer to *anti-patterns*, or common solutions to design problems that may seem appealing at face value, but which are actually counterproductive or detrimental. User interaction designers have also recently classified *dark patterns*, which are those that are "used intentionally by a game creator to cause negative experiences for players which are against their best interests" (Zagal, Björk, & Lewis, 2013, p. 45). The design requirements of games for learning suggest a need for a special class of patterns, which we call *frictional patterns*, that serve to reconcile competing aims that arise from educational and game design best practices, and which serve as explicit reminders of design compromises selected. We define a frictional pattern as *a pattern that is used in a designed experience which resembles a typical user-centered experience, where fulfilling a design requirement necessitates holding some proximate user interest in abeyance*. This definition acknowledges that users have a set of expectations on the basis of their prior experiences with other similar designs; we generalize the field of applicability beyond digital games, however, as frictional patterns may be used in traditional games, as well as in non-game-based computerized learning environments. This definition furthermore differentiates frictional patterns from dark patterns. While both types of patterns advance designers' interests in favor of users' interests, a frictional pattern is at worst a minor or temporary setback in users' goals and does not violate their long-term aims or autonomy.

Frictional patterns in practice

Researchers working in the sub-field of epistemic cognition have identified a need for designs that elicit evidence of learners' knowledge and justifications (e.g., Sandoval, 2012). Moreover, Chinn, Rinehart, and Buckland (2014) have argued that scholars must find evidence of learners' aims in order to interpret their epistemic practices. Consequently, a constraint adopted for the present work was to *design interactions that would render changes in players' attention more directly observable during the course of play* without requiring specialized hardware or clinical testing environments. This general technique was used by Danielak and colleagues (2014) in an early prototype of a museum-based game focused on engineering, where players had to explicitly open a modal window in the interface in order to review their progress. This action was logged on players' devices, allowing the study's authors to make inferences about players' goal orientations during play. It was therefore conjectured that using a similar pattern for actions that are performed frequently could provide one source of data regarding the trajectory and cadence of players' epistemic aims in a game.

The game used in this case study is a hybrid digital/tabletop game focused on paleobiology, where two players cooperate to uncover features of a specimen and are rewarded for using these features to make inferences about other features the specimen might have. Players use a companion app on touchscreen devices

to create mathematical models relating these features, and they can use these models to warrant arguments they make about the specimen. The app also serves as a personal reference, where players can inspect technical terms on-demand. While good game design traditionally calls for providing explicit information just-in-time (Gee, 2003), information essential for model evaluation was intentionally obfuscated behind interface elements in order to generate more unambiguous data regarding what players are looking at, how much time they spend looking at it, and so on. As such, the app's model browser displays confidence ranges for a predicted characteristic under different input conditions, but players must touch and hold on affordances in the interface to view detailed descriptions of the confidence ranges, as well as to see the *strength* values the model confers (the latter of which is the only piece of mechanically relevant information in the context of the game).

The data in the pilot test covered here come from two adults who regularly play games with one another. Data collected include audio and video recordings of the participants, video recording of the game board, as well as screen recordings and log data from players' touch screen devices. Neither the sample nor this study is intended to be representative of a broader population. Rather, we provide an example of how a *frictional design pattern* can impact players' learning and activity in a game.

At the beginning of the game, Player 1's utterances focused primarily on victory points and strength values, indicating a proximate aim of advancing her state in the game. The log and video data revealed that her reading of model descriptions in the app was fairly cursory during this period, focused on skimming to find strength values. However, when she created an argument with zero strength (a move not explicitly disallowed in the rules), there was some disagreement regarding how to interpret her model. For example, Player 1 suggested that the model indicated that "the likelihood of these two features leading to a predator is not...strong." to which Player 2 replied "the way I interpreted what it said was that it just doesn't have enough evidence to make the case that it is strong or not." Player 1 puzzled through this interpretation aloud, tentatively agreeing that "there's not enough evidence to, to predict one or the other." After this exchange, Player 1 spent longer periods of focused time interpreting descriptions in the app when creating new models. This shift, as evidenced by identifiable jumps in her cumulative time spent reading model descriptions following this event, reflected changes in her play strategy and hence her orientation from simply *how to score points* in accordance with the rules to *how to make a coherent argument*. The culmination of this effort occurred three turns later when she produced an argument to her satisfaction, exclaiming "Finally! I did something right."

Conclusions

The example discussed here shows how one low-level interface decision can explicitly deviate from traditional usability standards while generating evidence required to understand player activity. Characterizing this decision as a *frictional pattern* allows us to clearly document the expected impacts on usability and user comprehension. By explicitly defining frictional patterns in design work, it becomes possible to better qualify the positive value of specific impairments to usability in design-based research.

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