Designing Microgames for Assessment: A Case Study in Rapid Prototype Iteration

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ABSTRACT
In contrast to the trend toward large scale, immersive games that aspire toward the polish and experience of conventional commercial games, the authors offer a design case study for the potential of microgames and assessment. Microgames are designed to be small, pointed experiences more analogous to a single question than an entire exam. Instead of offering diverse mechanics, microgames are small punctuated play experiences. Microgames are rapidly developed games, targeting a relatively narrow set of skills.

It is speculated that microgame based assessments can support contextualized, focused interaction that allows for situated decisions within a relatively short time frame. This paper outlines the design heuristics learned in a collaborative project to develop microgames for assessment between a major testing and assessment organization and their academic partner.

Author Keywords
Microgames ; Educational Game Assessment ; Iterative Design and Development ; Educational Game Design Methods

ACM Classification Keywords
K.8.Games

INTRODUCTION
Games and education have coalesced in a variety of ways over the years. There have been games to teach, games to practice, games to simulate, game to incite social impact and a myriad of other purpose driven play experiences.

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Underlying these approaches is the fundamental goal to make the tasks involved in education more appealing. As the overarching philosophy applies, well-designed games are appealing because they address affective states, motivation, and expectancies of the player [11]. The fundamental challenge is of course, how to make such games engaging.

A variety of approaches to this challenge have been provided in the past. The common approach is to layer elements of challenge and engagement. To sustain student engagement, a game should be optimally challenging [6, 8,12]. Easy games require little effort or engagement from players while overly difficult games can inhibit interest because players are unable to accomplish goals. This balance is articulated through a variety of models, including the widely known balance of challenge and skill offered through flow design theory [1]. Other models that have been effective in game design include the play-centric approach, which champions rapid iterations through multiple game mechanic prototypes [4] and verb based design which champions formal structural approaches to the rhetoric of the game. In each of these design frameworks, the core unit of engagement is challenge.

It is also understood that challenge can be achieved through superficial design features (e.g., increasing the speed of on-screen elements, obscuring information) or deeper semantic features (e.g., more difficult content, systems of interactions). The latter approach has implications for educational game designers, especially as it relates to the zone of proximal development (ZPD) [9, 8]. Games at the zone of proximal development may sustain interest and engagement by providing accomplishment while maintaining effort. It also helps to define the edges of a student's zone of proximal development) ultimately such approaches bias toward weaving multiple elements into a complex interplay of game mechanics, aesthetics, and dynamics [7].

Many educational games follow a production model which includes producing traditional game design documents and

adapting heuristically informed assessment experiences toward more playful paradigms. This process is akin to the waterfall software development method. A method that is ineffective for small, lean and highly agile creative design teams[4,7]. Games designed under the weight of these older design approaches require significant resource outlay and time. They also tend to produce larger games, as the additional superficial and design features bloat the game experience and may sometimes distract from the core goals of the project. Much like the evolution experienced in the entertainment games industry, large educational games are in need of a lean process and design approach.

Taking the continued growth of simple mobile games as its model, this project endeavors to embrace the small-scale game experience which forms the common basis of many leading contemporary mobile games. The researchers embarked on a 1 year investigation into a methodology to improve the capacity and propensity for creating educational games for assessment. This approach is best described as microgame-based assessment. It incorporates high intensity design and development cycles similar to agile development's sprints with the design of games driven by a single, repeatable mechanic. These microgames seem to offer measurable efficiencies in developing educational games in a short amount of time.

BENEFITS OF MICROGAMES FOR ASSESMENT

Given the nascent character of this research, it is beyond the scope of this brief writing to articulate the formal elements of assessment, but the authors suggest those unfamiliar with it begin with Nitko [10]. In concept, this project seeks to adapt the question based assessment tradition toward microgames.

Microgames are generally rapidly developed games that target a relatively narrow set of experiences. They are often developed in jam-like sprints, where developers and designers invent and develop novel, untested game mechanics. Microgames can be characterized as relatively short interactions of 5-minutes or less. The primary "play" experience is defined through a small set of targeted game mechanics, with game rounds measured in seconds not minutes.

Microgames have many attributes which benefit particular types of assessment environments. Compared to other interactive and gaming formats microgames are: quick to develop and iterate, relatively low cost, provide good time to evidence ratio, target very specific knowledge and skills, are fairly simple to understand (no complicated interacting mechanics), and can be delivered across a variety of platforms (desktop, mobile, web-based, or apps).

Microgames can provide a contextualized, focused interaction that allows for situated decisions within a relatively short time frame. In practice, these games provide an opportunity to identify when students do indeed possess the target skills, but their knowledge may not yet be explicit and easily transferable (which would contribute to any formative feedback from the environment).

In addition to providing context for the interactions, a microgame relies on a focused set of mechanics that can be used to target specific constructs (i.e., match mechanics to a theory of action for a particular subconstruct). Lastly, microgames can be designed as self-contained entities which afford drastically different interaction tasks between games that could be played contiguously (unlike extended games that often need a consistent theme or narrative).

In short, microgames can be stacked, re-sequenced, or re-inserted with alternate aesthetics to create a complete assessment in the same way that quiz questions can be selected to create a complete exam. An interconnected suite of microgames may better afford the creation of detailed multidimensional diagnostic profiles, relative to survey-based measures. In combination, these potential benefits of microgames constitute a fertile area for assessment development and exploration.

The over-arching focus of this project is the exploration, design, and development of microgames as a form of assessment. This project sought to conduct foundational research on microgame design that will move the field of game-based assessment forward. This project seeks to find the common ground where both good assessment designs and good game designs intersect.

CASE STUDY

The larger goal of this research aims to help researchers understand more about when microgames are appropriate, which design elements are most beneficial, and how features should be combined with assessment practices. This brief paper aims to highlight the first step in this larger effort – the process of designing such games to embrace iteration and adaption to the myriad of challenges distinct to games for assessment.

The researchers selected the challenging field of argumentation as the focus for the pilot design activity. Argumentation is a critical skill for academic work in many fields and professions [5]. Thus, argumentation and understanding the logical components of argumentation are widely applicable skills important across a lifetime of learning and social interactions [13,2]. Argumentation skills of middle school students were selected as the primary target for these microgames. Students at this age exhibit a wide range of skills and competencies and may not yet have received direct instruction on argumentation concepts or use of evidence. Our goal was to develop a set of meaningful and engaging microgame assessments that provides accurate measures of student performance in argumentation and motivates students to apply these skills.

The assessment task chosen involved evaluating a player's skills in argumentation. The basis for evaluation was a set of existing argumentation contexts that require students to structure an argument based on supporting or detracting

claims to a central argument. Example tasks might provide the student with a context like "robots should have voting rights" which then must be supported with claims like "robots are very logical" or attacked by claims like "robots would not have human interests." The value of the claims used to support or attack a context can also be assessed for their overall strength.

METHOD

This research was conducted as a collaboration between the world's leading international non-profit educational testing service and a Washington DC based academic game studio. The assessment team was comprised of 1-3 educational researchers trained in argumentation assessment. The design team was comprised of two game artists and designers experienced in independent game production and game jams.

On a weekly basis each team convened to discuss their weekly sprint. Initial sprints included identification of argumentation context, production of 3-6 sentence game pitches, production of game content, prototype production, etc. The general form for the development process followed a dialogue model. For each of the games produced, this volley took the repeatable form of articulation and production. The team would discuss an artifact, create a new artifact, and discuss the resulting artifact weekly. The game was thus moved from a concept paragraph, to a rough mechanic, to a complete game mechanic and then to a completed game as in Figure 1.

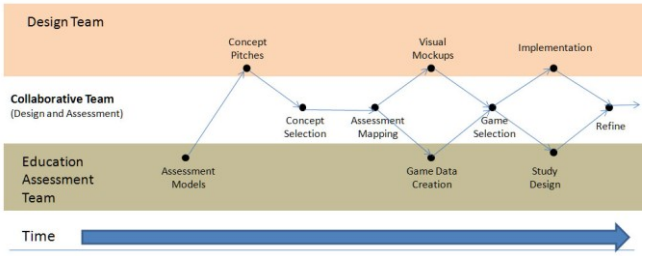

Figure 1. the process flow, outlining design team and educational assessment team activities, for creating each of the microgame assessment games.

For the topic in argumentation, this dialogue and process flow proceeded week by week as follows:

1. Articulation of common argumentation assessment models
2. Production of game concept statements based on common assessment models
3. Selection of game concept statements
4. Mapping of game concept statements to assessment needs
5. Creation of interaction mechanics mockups
6. Creation of basic game data for prototypes
7. Converting interaction mechanics to complete Game mechanics Mockups
8. Evaluation of game prototypes of game mockups
9. Creation of digital prototypes
10. Evaluation of digital prototypes
11. Refining digital prototypes
12. Assessing digital prototypes

The result was a fairly organic evolution of the games. There was never a game design document for the games produced. Nor was more than 1 developer needed to produce each prototype or more than 1 artists needed to produce the concept art. Instead, the games were executed in a process that combines aspects of game jams with client-driven projects.

For each phase a single person was responsible for managing a core task. Sprint cycles were generally alternated so that no one half of the collaboration was in a perpetual sprint from week to week. Likewise, the sprints were very small, complete cycles. To mitigate overinvestment in technology, game design was first critiqued through 3-6 sentence concept statements. The concept statement exemplified in the following example:

> *Pitch: Make Me Believe*
>
> *Selecting from a set of 3 claims, the player must architect the best argument in a few seconds. Each type of claim is at first color coded, then as they play the arguments become more and more specific. The first level they are choosing between a piece of factual evidence (red), a popular claim (green) or a subject matter expert's claim (blue). As they progress the colors become less distinct and the claims more grey*

These pitches were refined through dialogue into age appropriate metaphors and game scenarios. Based on the evaluation sprint, the subsequent design concepts were created as shown in figure 2.

Figure 2. Four sprint mockups for argumentation microgames used to inform the final design. Players sort sandwiches based on strength of argument (top left), remove the ingredient that least supports the argumentation context (bottom left), players remove the wrong argument ingredients from their dessert (top right) and players send bees to support a claim

Once the microgames had taken a visual form, it was easy for the collaborators to discuss concerns in engagement and incremental increases in challenge. The benefits and drawbacks of specific game metaphors also became

apparent. As a result, the prototype stage was well informed by both teams. Instead of working to predict the probable challenges of designing the microgame, the team members found themselves interrogating the design to reveal opportunities and challenges earlier in the design process. This approach afforded for some of the basic benefits of traditional iterative design by allowing artifacts to be created quickly, but it also afforded for intellectual distance and collaboration between sprints. The dialogue based structure forced both collaborators to engage in consistent dialogue in a timely fashion.

RESULTS

Producing educational games through a two-team dialogue is admittedly impractical for large scale projects. However, for microgames, where the project scale and scope are limited to a very focused exercise, it proved quite practical. Using this dialogue structure, the project produced a game prototype functional for pilot study. The prototype asked players to sort robots at a factory based on whether they support or detract from a claim. The final design prototype is shown in figure 3.

Figure 3. Final playable prototype for argumentation context, robots make claims and players sort them by swiping up or down

Notably the project evolved significantly from the original concept statements and from the mockups. In each dialogue between sprints, the game was organically refined. Positively team members articulated that the sprints afforded artists and designers the ability to create work and get an idea "out of their head." Likewise, weekly sprints forced the collaborators to stay in dialogue instead of producing hand-off documents that can easily be misinterpreted. Negatively, they noted, that keeping development within a single week was challenging when balancing other development tasks. Unlike a typical game jam, producing the game quickly meant that the data provided by the collaboration team had to be well structured. This didn't allow much time for designing data schemas or designing large scale, reusable code. Finally, and perhaps most importantly, the concept to production pipeline was reduced to a fraction of the typical 12 month or greater cycle experienced by the collaborators for previous projects.

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