Design Decisions and Educational Games: Insights for Acceptance

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Abstract: This study extends previous work (Kinzer, Turkay, Hoffman, Vicari, De Luna, & Chantes, 2013), through a survey of game designers. The work presented here provides insights into decisions made by game designers designing educational, as opposed to entertainment-focused games, in an attempt to link design and development decisions to the infusion of games into classrooms by addressing barriers to classroom adoption. Questions and issues addressed include: What are the decisions that go into determining what games are produced, what educational theories are embedded in designs (and how those decisions are made), what determines the content areas targeted by design decisions, and how game designers' use of educational focus groups and marketing strategies influence the adoption of educational games.

Background Assumptions and Rationale

Many educational practitioners, scholars, and researchers suggest there is great potential and educational benefit to digital games (e.g., Gee, 2003; Squire, 2011), and the past decade has seen a continuing effort to implement educational games into classrooms. Often, these efforts cite research showing that students tend to better assimilate their lessons if they are able to experience what they are to learn through simulated worlds that encompass computer games, which require learners to address content, presented at appropriate levels, within a fantasy world experienced by the player/learner (Malone, 1981; Gajendra, Sun, & Ye, 2010; Gee, 2010; Duncan, 2010). In arguing that games are a new kind of literacy aimed at honing students' cognitive interpretive skills, Connelly (2010, p. 3; see also Steinkuehler, 2007) refers to computer games as a way to challenge and engage sometimes ineffective, conventional procedures of school-based learning. Yet, although use of games in classrooms is increasing, Schwartz (2014) notes that "many teachers still use them primarily as supplemental material or as a reward when the 'real work' has been accomplished, not as the main instructional tool." (para. 2)

From this perspective, when compared to the growth of games played by school aged children generally, there is a somewhat less optimistic view about progress toward the use of educational games in classrooms. Consider, for example, that "There is an average of two gamers in each game playing U.S. household and the average U.S. household owns at least one dedicated game console, PC, or smartphone" (ESA, 2014, p. 2), and that the prevalence of games in general use involves a huge part of disposable income: $15.4 billion in 2013 was spent on computer and video game purchases (ESA, 2014). Similar, exponential growth has not occurred for game-use in instructional situations in schools. Thus, while computer games, particularly online or digital games, arguably enhance students' metacognitive capacity and learning as they require students to continuously assess, reflect, evaluate, amend and rectify their thinking in the learning process, it is important to come to understand what issues, especially from game designers' perspectives, may be factors affecting the relatively slow growth seen in educational game-based implementation. By examining the influences and manner in which educational game design decisions are made, we hope to gain insights that could provide recommendations to designers and information to educators leading to productive ways to increase acceptance of educational games in schools. To this end, through a survey of educational game designers, this paper presents work that examined challenges and issues related to educational game design and development from conception to production, with a view to understanding the barriers and difficulties that prevent the implementation of those games in educational settings.

Procedures and Description of the Study

A survey was created with educational game designers as the target audience, as distinct from game designers who produce other types of games (e.g., entertainment games). Twenty-seven questions were tested by two game designers who rated the questions and overall survey for length, flow, and clarity. Based on their feedback, the survey was finalized and divided into three sections: "conception of," "design and development of," and "distribution of" educational games. The survey included Likert scale, multiple choice, and open ended responses. Likert scale and multiple choice responses were analyzed as numerical data, while open ended responses were coded through a qualitative content analysis that served to extend and triangulate the numerical data. The survey was deployed electronically through listservs, social media platforms, personal contacts (along with requests to for-

ward the survey to appropriate colleagues), and fliers with a link to the survey posted at game designer meet-ups, conferences, and so on. Participants received a reminder email for survey completion three weeks after their first invitation email or link to the survey. A total of 122 people answered part or all of the survey; 55 (45%) answered all questions. This completion rate is due, in part, to the structure of the survey (recall, above, that there were four parts). As not every part would be applicable to all respondents, perhaps because of their specific job responsibilities (some designers, for example, have input to decisions about final game distribution while others do not), we were not surprised that not all participants completed the entire survey.

Analysis

Responses were analyzed by frequency for multiple choice questions. As not all parts of the survey were completed by each respondent, where we report percentage of respondents we also report the number of respondents who answered a given question and, if applicable, the percentage of respondents *within that question's* multiple choice categories. To clarify, in a yes/no question 15 of 55 respondents may have responded "yes," while in a different yes/no question, 10 of 50 may have responded "yes." Thus, we make clear, in Table 1, the number of respondents for a given question when presenting subcategories of results. For written, open ended responses, inductive content coding was used. Four members of the research team separately coded the responses based on an initial coding scheme, adding codes as needed. In subsequent meetings, coding categories were added or removed depending on consistency of coding across coders, with disagreements resolved by mutual agreement. The written responses were then recoded, based on the agreed upon final coding scheme.

Results and Discussion

A number of studies provide information about what teachers see as barriers to the classroom implementation of games (e.g., Rice, 2007; Schwartz, 2014; Fishman, Riconscente, Snider, Tsai, & Plass, 2014; Takeuchi & Vaala, 2014). While such studies confirm teachers' concerns about technology infrastructure, these concerns are ebbing as technology in schools, and the availability of games on mobile devices, become increasingly available. More germane to the study reported here are findings that "Most teachers…report using short form games that students can finish within a single class period…[and] may also find shorter-form games to be easier to map to curriculum standards" (Takeuchi & Vaala, 2014, p. 5), and that "nearly half of teachers report they are unsure of where to find quality games and that it is hard to find games that fit their school's curriculum" (Fishman et al., 2014, p. 4). Summarizing across such studies and findings, teachers appear to resonate with games that link to their curriculum, that can be played in class during short periods of time (with longer play occurring in out of class settings), that explicitly match State and core curriculum guidelines, and that match their instructional approach (which we interpret as games that are explicit about their use of learning theory). Teachers also state a desire for help in locating games that might be appropriate for their use. Thus, the results reported below come from portions of our survey designed to explicitly address the above-noted areas, which can be categorized into the appropriateness of content, explicitness of links to curriculum and standards, explicitness of links to implementation of learning theory, and marketing that reaches teachers and targets awareness.

Choice of Content and Subject Area Decisions

Several questions addressed issues of content, including questions that asked how decisions were made to develop and create a game, how a game's content and content area were determined, and whether content experts were used in a game's design and development. Our survey revealed that the factors resulting in the development of educational games were based on perceived (immediate) *needs* and specific *requests* (see Table 1, No. 1), rather than long term, sustainable curricular implementation plans. Respondents shared information on 41 unique educational games; the majority of games being developed were in STEM subject areas.

Respondents' team members' expertise in game production played an important role in determining the content of games. The majority of *Other* responses (see Table 1, No. 1) reported content based on personal interest or expertise. This was also true when there was a team working on the game content: expertise and the group's interest were the determining factors for game content. In relation to this topic, when the survey asked what specific expertise was needed in developing the game (see Table 1, No. 7) the highest response was content experts. In addition, with the need for content experts being the most desired area of expertise, teachers (who would be considered educational experts) may be crucial from an early stage in educational game development, but are often absent.

No.	Question and [Total Responses]	Response Choice	No. of Responses	%
1	How did you choose game content? (Choose all that apply.) [68]	Needs analysis	30	44%
		Client request	25	37%
		Market research	18	26%
		Other	24	35%
2	How did you choose your target audience? (Choose all that apply.) [50]	Needs analysis	22	44%
		Client request	15	30%
		Market research	14	28%
		Other	21	42%
3	What are your or your team's thought processes before moving towards designing a (educational) game? [54]	Objective of the game	13	24%
		Client request	9	17%
		What is needed in the market	7	13%
		Choose core game mechanics that go well with learning objectives	6	11%
		Engagement	6	11%
		Other	13	24%
4	Which one of these drives the design process? [47]	Game mechanics	14	30%
		Game content	18	38%
		Equally across both	15	32%
5	What primary methodologies did you use in developing core game mechanic (Select top two) [50]	Literature review	18	36%
		Playtesting	39	78%
		Market research	7	14%
		Other	36	14%
6	What learning theories did you implement in the design of the game mechanic? [42]	Constructivism	10	24%
		Constructionism	6	14%
		Instructional design	6	14%
		Social learning theory	4	10%
		Other	16	38%
7	What kinds of expertise were needed in developing the (educational) game? (Choose all that apply.) [86]	Content expertise	31	36%
		Programming	21	24%
		Game design	19	22%
		Graphic design	15	17%
8	Which strategies would be the most effective way to market your game? (Select top two) [32]	Conference/Convention	14	44%
		Website(s) and social media	20	31%
		Word of mouth	9	28%
		Other	21	65%

Table 1: Comprehensive results from the survey

For our respondents, market research seems to be of relatively little consideration in determining the subject area in educational games. This is different from entertainment game development (EGD), where Competitive Analysis (as part of a pitch document) includes details about how the game may fare in the marketplace by listing the unique features of the game being developed, number of other games that have been shipped recently that are similar to the one under consideration, and a detailed synopsis of how those similar games performed in the marketplace (Rouse, 2005, p. 309). If EGD is chiefly driven by potential profit, educational games appear to be driven more by perceived subject area needs and requests, with educational games often being developed "on spec" with the hope that monetary returns will follow. We believe that this downplaying of market research is linked to relatively low incidence of educational game advertising, thus impacting awareness of a game's availability, and encourage more emphasis in this area to build teachers' awareness of games to positively affect infusion into classrooms.

Links to Curriculum and Standards

As noted earlier, a barrier that prevents games from entering classrooms is that most games are not well and explicitly aligned with school curricula. A recent national survey indicates that integration of games to curricula, except for time and cost, is the greatest barrier for in-classroom game use (Takeuchi & Vaala, 2014). In most cases, teachers have to infer and develop the alignment between a game and their curriculum, with little time available to do so (Squire, 2004). Moreover, when a game is not explicitly linked or adaptable to National or State standards, teachers often resist adoption (Deubel, 2002). Although National Standards were mentioned in the *Other* category in Table 1's No. 1, integration into the school curriculum was rarely mentioned. Given other work that indicates teachers make game-integration decisions based on links to their curriculum (e.g., Fishman et al., 2014), these results support the possibility that game developers' lack of attention to specific alignment of a game to its target curriculum content is holding back teachers' adoption of educational games.

One way to ensure curriculum links is to ask professionals who are potential adopters, i.e., teachers in the content areas targeted, to test the game for playability, appropriateness of content, and fit with State standards and curriculum. Our survey showed that respondents did indeed playtest their games, and did so with a game's targeted users (learners), and educators. Developers themselves also playtested their games. However, playtesting was done mainly for playability—only 17% of responses noted that playtesting occurred with content providers who could state whether content was appropriate to the subject area being addressed. Overall, our results show that the developers utilize playtesting as a critical part of their iterative design process, but that they tend to focus on the game-side aspects, and not the content, curriculum, or learning aspects of the game in a playtesting process.

A majority of respondents stated that games best support interactive and constructivist-based pedagogy or instructional strategies, within inquiry and project-based learning (see Table 1, No. 6). Dynamic interactivity and feeling of agency were mentioned as frequently as pedagogy and instructional strategies. These responses did not particularly mention educational merits of interactions (e.g., cognitive engagement), but tended to emphasize the play experience itself rather than how the experience related to learning. It is notable that some respondents explicitly stated that they are *game developers* and do not perceive games as a type of "instructional media." Only one respondent claimed taking existing curricula into consideration within the game development cycle, and only one explicitly indicated seeking to provide curriculum-supporting materials (such as lesson suggestions or lesson plans) along with the game, although teachers report that having such materials available is important to their adoption decisions.

Links to Learning Theory (and Integration of Mechanics to Content)

Literature suggests that game mechanics grounded in learning theories yield better learning outcomes (Plass et al., 2012). However, teachers' beliefs about learning and appropriate methods (e.g., on continua from child centered to teacher centered, holistic to. skills based; behaviorist to constructivist, situation to decontextualized) must match teaching materials, or they are less likely to be used (Kinzer & Carrick, 1986; Kinzer & Yount, 1991). Absent an explicitly stated link to earning theory, teachers may have doubts about how a game might fit into their curriculum (as described in the following section), or how a game's approach to learning fits with their own pedagogical beliefs and approach. Thus, our survey asked several questions aimed at understanding how learning theory fits into game design and development.

We asked what learning theories guided decisions about game mechanics. A majority of participants identified constructivist approaches as their guiding learning theory, although responses varied from instructional strategy level (e.g., inquiry learning) to larger frameworks (e.g. constructivism), see Table 1, No. 6. This pattern of responses corresponds to claims that game based learning has been receiving growing attention because of learner-centered learning paradigms, the basis of constructivist learning approaches (e.g., see Garris et al., 2003), and that well designed video games provide spaces for social interaction, collaboration, and experimenting with new ideas, which can support learning through experiences (Kolb, 1984). A cross-examination of responses related to game descriptions and mechanics showed that respondents' stated game mechanics reflected their learning theories: e.g., simulation games were related to situated learning, inquiry based learning or constructivism. Some respondents (14%) gave specific examples related to constructivist learning, such as having players create a tangible artifact (e.g., a storyline) throughout gameplay. Very few respondents stated that their games are not guided by any learning theories.

In educational games, game mechanics must relate to learning outcomes to achieve desired learning gains (Plass et al., 2012). The game context should have an integral, endogenous relationship to the learning material (Malone & Lepper, 1987), so that the game context does not overload player's cognitive capacity (Killi, 2005). Thus, we asked whether, and if so to what extent, a game's content guides the game mechanics or vice versa to see what

the respondents considered more important in game creation. Among the 47 responses 15 participants gave equal weight to content and mechanics, while 32 felt that game mechanics or game content was most important, respectively (see Table 1, No. 4). Game mechanics are inevitably tied to players' learning as, of course, is content. Yet, game mechanics are central to learning content, as without playability content cannot be foregrounded. This is related to Gee's (2008) claim that learning is a fundamental part of all games, and to Plass et al. (2013, p. 697), who note that "At a minimum, players must learn the basics of a game's mechanics in order to play...The mechanics of the game not only define the behaviors and actions players take, but directly facilitate players' understanding of the game and what the game may be representing or aiming to teach." In this way, game mechanics and learning are tightly related and depend upon each other. That 30 of our respondents foregrounded content over mechanics may thus be a concern to teachers who are most concerned with learning and who would examine how content is addressed through game mechanics.

The list of game mechanics participants provided also gives insight into this area. For instance, storytelling or story generation was a very common mechanic in literacy games. This also corresponds to the overall trend that respondents tend to view content driving the mechanics in educational game development. Playability of the game—whether the game mechanics are simple, easy, and age appropriate—are the second primary standards. Interactions that are engaging were certainly an important consideration, but not as much as simplicity of mechanics. Based on these standards, developers select core game mechanics, and playtesting is the most common method to select them (see Table 1, No. 5). This is indicative of the iterative game development process. Given that playtesting and prototyping are the core of iterative design processes (Salen & Zimmerman, 2004; Squire, 2011), these responses capture the essence of iterative design, where design decisions are made based on gameplay experiences (Salen & Zimmerman, 2004).

To summarize our results in this area, we were left with the impression that game mechanics related to learning were implemented intuitively or for motivational purposes, with little conscious awareness of the need to apply learning mechanics explicitly, in ways that teachers could see. As noted earlier, some respondents explicitly stated that they did not perceive games as a type of instructional media. Such beliefs imply that the need for understanding learning design in ways that are explicitly applied to educational game design and development is less important than understanding gameplay. However, we would argue that without clarity about a game's underlying learning theory, teachers cannot easily realize how a game being considered would fit their teaching approach or their personal beliefs about good instructional practices, and the lack of such clarity can have detrimental effects on adoption decisions.

Marketing and Distribution

In terms of marketing and creating awareness of educational games in the general public, responses suggested the developers felt that the most effective marketing strategies related to attending conferences/conventions, followed by advertising on websites and social media, and word of mouth (see Table 1, No. 8). Few game developers reported that they had to deal with marketing and distribution, because their clients would take over once the game is developed. To initiate the circulation of educational games, more effort could be made through efficient and organized distribution strategies of bringing available games into classrooms.

Conclusion and Implications

Educational game developers were surveyed to examine the game design and development process from conception to distribution. Throughout the survey questions, responses consistently showed that the ultimate goal of the game development process was to meet educational objectives. However, only one third of the participants responded that they were partnered with subject matter experts or educational researchers to receive guidelines regarding factors related to concerns of teachers who might adopt games into their classrooms.

Systematic collaboration between teachers and game developers can aid successful game implementation as well as development of better educational games. Teachers can partake in the conception stage as sources of needs analysis, guides in the design of overall classroom experiences involving a game, and playtesting. The present survey revealed a lack of such partnerships, although the game developers desired more collaboration with experts in content and learning theories. Given that many teachers are using games that they do not themselves develop, collaboration even after the initial game design and development stage can improve the adoption of games into classrooms. Game developers should consider systematic ways to collect feedback from teachers. Creating a well-publicized, and perhaps crowdsourced repository of game-reflective activities and materials could also assist in publicizing the curriculum linkages and learning theories used in games, and result in greater in-class game integration.

Our survey results, consistent with previous work, found that the majority of funding for educational games has been put into the process of design and development, with relatively little funding for marketing, publicity, building awareness of availability, and distribution once a game is completed. Yet, a major part of adoption considerations is related to awareness—if teachers don't know what's out there, they can't adopt it. We found that while educational games often received significant amount of time and effort during development, there is often little effort made to publicize a game's availability. Perhaps more important, however, is *what* to publicize. It is imperative that teachers know (1) how an educational game fits into their curriculum, (2) whether or not ancillary guides and lesson plans are available, (3) how the game links to core standards, and (4) what learning theory is incorporated into the game. Being explicit about these areas will do much to address teachers' concerns and will facilitate the implementation of educational games into classrooms.

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