Accountable Game Designs For Classroom Learning

Timothy Charoenying
Doctoral Candidate
University of California Berkeley
Berkeley, CA, 94720 USA
timothykc@berkeley.edu

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Abstract

A simple yet powerful design strategy for leveraging children's natural proclivity to play has been to tie educational content to the rules of a game. A common criticism of many game designs used in classroom settings however, is that they fail to meaningfully embody content. Another, more subtle problem, is that design elements such as chance and skill; competitive versus cooperative roles; and criteria for success can influence the affective dispositions for students to participate, and by extension learn. While strategies for creating and understanding games ranging from athletic activities to video games have been articulated, there continues to be a need to examine the theoretical elements of game design in order to develop a practical, coherent pedagogy of implementation and use that is applicable to games, teacher practice, and curriculum. This study is focused on examining the socio-cultural forces that motivate students to play and, potentially, learn when they participate in in- and out-of-classroom games as well as the cognition and construction of knowledge structures that take place while playing, and is intertwined with my work on designs for *accountable games*—playful activities that take into consideration both the learning requirements and goals of the educator and the social and developmental needs of the learner.

Keywords
Child centered requirements,Collaborating children, Design guidelines, Design methods, Education, Games, Interaction design

ACM Classification Keywords
A.0 General: Conference proceedings

Background and Objectives:

Schank [12] has argued for the pedagogical value of design that simulates authentic goal-oriented activity. His 'goal-based scenarios' demonstrate one strategy that educators have historically employed to motivate students—creating content-infused learning games for students to play. Yet *play* itself is difficult to define, because of its infinite forms and variations: Piaget [9]]described *games* as play activities that are socially bounded by rules, and Vygotsky [14] described play as the "leading activity that determines the child's development"(p.103). Indeed, a simple yet powerful design strategy for leveraging children's natural proclivity to play would be to bind the utilization of target content to the game's rules.

Games transfer the perceived agency from the teacher to the student, and social games provide opportunities for observational learning as well as peer interaction. Nasir's [7] studies of African–American youth playing culturally embedded games, such as basketball and dominoes, revealed that a confluence of identity and practice-linked goals determine the potential of youth to learn content as well as the nature of this knowledge (see also Meira, [5]). Indeed, Lave [3,4] argues that learning is an inherently situated phenomenon, one that is greatly influenced by the intersection of the individual's needs and the context of practice.

Conversely, it would appear, games present an opportunity to create within a classroom a community of practice [15] around play-contextualized curricular content.

I conduct design-based research on socio-cultural forces that motivate students to play and, potentially, learn when they participate in in- and out-of-classroom games as well as the cognition and construction of knowledge structures that take place while playing. These studies are intertwined with my work on designs for *accountable games*—playful activities that take into consideration both the learning requirements and goals of the educator and the social and developmental needs of the learner. Whereas Salen and Zimmerman [11] have articulated strategies for creating and understanding games ranging from athletic activities to video games, and others such as Michael [6] have delineated design principles for making "serious games" for learning, I wish to further examine the theoretical elements of game design in order to develop a practical, coherent pedagogy of implementation and use that is applicable to games, teacher practice, and curriculum. In short, if we are to substitute traditional design with play-based activities, then it is incumbent on us, as designers, that the design should actively engage students in learning meaningful content.

Research Questions and Expected Contribution(s) to the IDC Field:

A common criticism of many game designs used in classroom settings is that they fail to meaningfully embody content. Given that we live in an age of academic accountability, it is no longer sufficient to design games that kids find "fun" and "interesting"—the

games must also provide powerful opportunities of learning. Toward these ends, Shaffer [13] has been researching *epistemic games*, designs that engage students in roles, responsibilities, and tool use that simulate the practice of real-world professionals. However, whereas game designs modeled after such authentic practices of adults have much to offer, there is still room, I believe, to conduct a more ground-level examination of game designs that can be implemented into the daily life and curriculum of public school classrooms. After all, the classroom and its "mandated goals" and "standards" *is* part of a student's "real world" [3]. Leveraging the cross-cultural game instinct, I wish to create principles for design that provides powerful opportunities for learning irrespective of students' social, economic, or technological background.

Another major problem neglected in the field of educational game design research has been a close examination of the underlying social and structural mechanisms of games that determine whether or not the game will promote and encourage learning. How do competitive as compared to collaborative games differentially impact students' affective disposition toward content and schooling? Which contexts and content may best benefit from a game orientation? What is the relation between a game's complexity and student participation? Namely, should the complexity be at the level of chess so as to encourage sophisticated strategic thinking and planning, or should the game be at the difficulty level of checkers to ensure broader participation? To what extent should *skill* and *chance* be designed into the games? In addition, a potential for *surprise* is a critical element in games for students and adults alike. For example the Super Bowl's ratings would be deplorably low if the final score were predetermined. Of interest to designers then, is how best to deliberately imbed these phenomena—skill, chance, surprise, etc.—into accountable games.

Conversely, it is important to also consider the structural mechanisms that discourage learning in the classroom. For example, game designs that reward students for knowing answers *faster* than their opponents are liable to undermine most students' sense of self-efficacy, because students are sensitive to their academic aptitudes relative to others, just as surely as they know who runs the fastest or is the most popular. Therefore, quiz-show games à la *Jeopardy,* in which the objective is to shout out an answer before your competitor, can be highly detrimental to learning, because the determining factor for success is not faculty of reasoning or problem solving ability, but speed of recall. In fact, the final outcome of such competition is perceived as preordained, and as a result the game becomes an example of "competitive practices where many are doomed to failure for the success of a relative few" [1].

'Math Agent': Design-Based Research of an Accountable-Games Proof of Concept

The Mathematics Learning Committee identifies [8] procedural fluency as a key strand for developing mathematical fluency. Dissatisfied with traditional classroom games and tools that set up calculation speed as the determining mechanism for game play, I created a mathematics card game called *Math Agent* (*see Figure 1, follow page*). I wanted a medium that students could also use at home or playground, so I

chose a playing card format (the game is equally implementable in digital mediums).

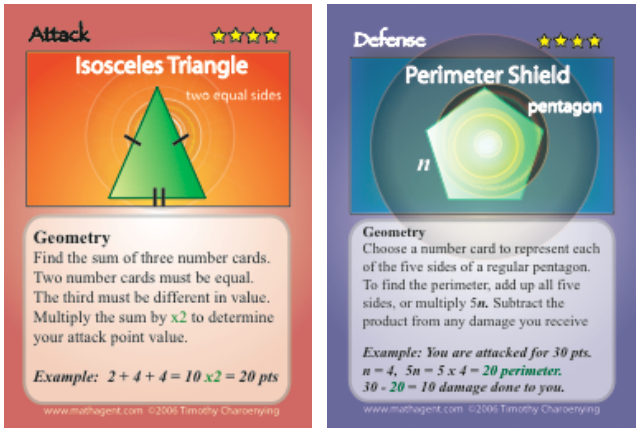

figure 1. Two examples of cards from the Math Agent set: An "attack card" using the term isosceles triangle (on the left), and a "defense card" using the term pentagon (on the right).

The game play format incorporates arithmetic operations and vocabulary from the 3rd, 4th, and 5th grade mathematics standards. It is important to note however, that from a Goal-Based Scenario perspective [10], the objective of the game is not to "do math" but rather to compete against an opponent, with arithmetic being an embedded design choice as the mechanism for enacting game play. To eliminate the potentially deleterious effects of speed, the game uses a "turn-based" structure. That is, playing is not dependent on shouting out the product of '4 x 5' faster than your opponent, but on the player's success in eventually figuring out that 4 x 5 = 20. In fact, the social nature of the game allows players to draw upon the group's distributed cognition [2], so that a student might even learn the answer to 4 x 5 from a peer while playing. The design has also purposefully taken into consideration factors such as skill and chance. The "luck of the draw" determines one's hand of cards, but at the same time strategy and experience are the ultimate determinants of success or failure.

Math Agent has been informally tested in New York City public elementary schools amongst low-income, immigrant, special- and general-education populations. From anecdotal evidence, one individual stands out in particular, a fifth-grade special-education student who had been held over twice. Typical of students who are repeatedly faced with learning failure, the student was withdrawn and reluctant to engage in traditional attempts at remediation. Using *Math Agent* as a peer-supported intervention, the classroom teacher observed a dramatic shift in the student's basic computational abilities as well as his affective disposition toward mathematical content.

Although the *Math Agent* design influences procedural knowledge and disposition, a closer analysis is required to determine whether students indeed develop conceptual understanding and mathematical reasoning. A known tradeoff in this design is that the competitive structuring of the game typically appealed to boys more than girls (albeit with some exceptions). In a classroom pilot study beginning May 2008, I will attempt to systematically correlate the effects of accountable games on student interest and motivation as well as to measure and observe emergent social factors, such as inter-player learning and teaching. The study will revisit *Math Agent* as well other games used by the teachers and students at my research site.

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