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ARTICLE

Designing Online Environments for Expert/Novice Collaboration

Wikis to Support Legitimate Peripheral Participation

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Abstract / Designing environments that can bring novices and experts together is not trivial. We explore how we can design environments where these collaborations happen in such a way that everyone benefits. We explore these questions in the context of one such environment. In this study, we used the Game Ontology Project (GOP), a wiki-enabled hierarchy of elements of gameplay used by game studies researchers, in a game design class. Students found that their participation was enjoyable and useful for learning. Also, there is evidence that they developed a deeper understanding of the medium of videogames. However, encouraging sustained participation was challenging because students tended to view the GOP as a static source, rather than a participatory and editable resource. Expert analysis of the students' contributions to the ontology found them to be useful and significant. We conclude with thoughts on the importance of these kinds of authentic environments in traditional learning.

Key Words / collaboration / games education / games literacy / Game Ontology Project / legitimate peripheral participation / wiki

Introduction

Theorists such as Yochai Benkler (2006) and Henry Jenkins (2006) make a compelling case that the fundamental distinction between novice and expert is being transformed by new communication technologies. This shift has the potential to democratize the process of content creation, allowing a larger and more diverse group of people to contribute. However, realizing that potential in practice is a complex socio-technical design activity, in this article, we offer a model for using participatory tools to build and develop a body of knowledge around a particular domain in such a way that both experts and novices gain from the experience. In the process, we contribute to our knowledge of the use of new media, especially wiki technology, for educational applications.

Designing environments that can bring novices and experts together is not trivial. However, many of the issues and challenges of designing these environments can be explored through the analytic lens of communities of practice. Lave and Wenger (1991) proposed the term 'communities of practice' to highlight the importance of activity in linking individuals to communities, and of communities to legitimizing individual practices. A community of practice involves a collection of individuals sharing mutually defined practices, beliefs, and understandings over an extended time frame in the pursuit of a shared enterprise (Wenger, 1998). Roth suggested that these kinds of communities 'are identified by the common tasks members engage in and the associated practices and resources, unquestioned background assumptions, common sense, and mundane reason they share' (1998: 10).

Lave and Wenger (1991) describe the mechanism of 'legitimate peripheral participation' (LPP) as a crucial part of learning in a community of practice. Initially, a member will participate in activities that are important (legitimate) to the community, but are perhaps not the central focus of that community's practices. Lave and Wenger (1991) propose that an extended period of legitimate peripherality provides novices with opportunities to make the culture of practice their own. This notion highlights the difference between 'taking part' and 'being a part'. The former being common, but the latter being preferred.

The success of a community of practice has to do primarily with social, cultural, and organizational issues, and only secondarily with technological features (Wenger, 2001). However, communities of practice today are increasingly relying on some kind of technology for their activities and researchers have begun to explore the role that technology can play in supporting them (Johnson, 2001; Wenger, 2001). For example, Squire and Johnson found that interactive television could overcome physical boundaries and provide novice participants with trajectories into participation (2000). The online encyclopedia Wikipedia can also be viewed as a community of practice that exists entirely online (Bryant et al., 2005). Research has shown that rather than encourage anarchy, Wikipedia has evolved into a community that places a strong emphasis on group coordination, policy, and process in order to pursue the common goal of creating and maintaining an online encyclopedia (Viegas et al., 2007). However, using technology to support the collaboration of novices and professionals in an online community poses additional challenges. Online communities can focus on discourse about knowledge to the detriment of identity formation – learning to be – (Hung and Nichani, 2002). Also, tools for supporting online collaboration may not be used in expected ways even when their designs have been adequately informed by theories and research (Schwen and Hara, 2003). Perhaps the greatest challenge is that communities of practice are n'ot likely to be forced, but rather they emerge (Schwen and Hara, 2003). Thus, in addition to wondering how we can support novices entering the community, it is important to consider the characteristics of the existing community of practice in order to nurture it.

In what ways can novices and professional researchers collaborate? What sorts of contributions can novices make and what role can technology play? In this article we explore how we can design environments where these collaborations happen in such a way that everyone benefits. In particular, how can we use technology to create environments that are (RQ1[1]) approachable to novices, (RQ2) allow novices to contribute legitimately to external communities of practice, (RQ3) support visibility and access to the practices of a broader community?

We explore these questions in the context of one such environment, the Game Ontology Project (GOP). The GOP is a research project used by members of the field of game studies to carry out original research. Starting in 2007, it was integrated with a university-level games class to help students learn and develop a critical vocabulary for talking about games while providing them with the opportunity to contribute to the emergent field of game studies. We will outline the role played by this game studies project and the wiki technology on which it was implemented. In particular, how it scaffolded and afforded the exploration, reflection, discussion, and contribution of concepts and terminology related to videogames. We argue that participating in the Game Ontology Project helped students use their personal experiences and knowledge of videogames to establish connections with abstract concepts and ideas while contributing meaningfully and legitimately to the academic study of games. Our analysis also includes the evaluation by game studies experts on the quality, type, and role played by the students' contributions. The results of this experience, both positive and negative, provide insight into the more general problem of finding ways to help experts and novices work together online.

Game Studies and the Game Ontology Project

Game studies is an academic discipline that is currently developing as an extension and reformation of existing scholarly and scientific communities and practices. Game studies researchers tend to come from the social sciences, humanities, computer science and engineering. It is a community that is still experiencing 'growing pains' as it begins to define its identity and essential problems. As we will discuss later, this situation provides a unique opportunity to explore how professional researchers and students, novices, and non-professionals can collaborate and build new knowledge together.

Game Ontology Project

The GOP is a research effort that seeks to provide a principled means for describing, analyzing, and studying games. The product of the GOP is a game ontology that identifies the important structural elements of games and the relationships between them, organizing them hierarchically (Zagal et al., 2007). Used as a tool, the ontology can help inform and guide the analysis of games as well as provide a framework for the discussion and exploration of the design space of videogames (e.g. Neubauer, 2006). The term ontology is borrowed from computer science, and refers to the identification and (oftentimes formal) description of entities within a domain. In describing structural elements of games, the ontology's entries are often derived from common game terminology (e.g. level and score) and are then refined by both abstracting more general concepts and by identifying more precise or specific concepts.

Each ontology entry consists of a title or name, a description of the element, examples of games that embody the element, a parent element, potentially one or more child elements, and potentially one or more part elements (elements related by the part-of relation). The examples describe how the element is instantiated in specific games. There are two types of examples, strong and weak. Strong examples are 'obvious' or canonical exemplars of a particular entry, while weak examples describe borderline cases

TABLE 1

Example Ontology entry – 'To Own'

Name	To Own
Parent	Entity Manipulation
Children	To Capture, To Possess, To Exchange
Description	Entities can own other game entities. Ownership does not carry any inherent meaning, other than the fact that one entity is tied to another. Ownership can change the attributes or abilities of either the owned or owning entity. Ownership is never permanent; the possibility of losing ownership separates ownership from an inherent attribute or ability of an entity.
Strong Example	In *Super Mario World*, Mario can collect mushrooms (or fire flowers or feathers) to use later. Mario owns these entities and can choose when to use them.
Weak Example	In *Ico*, the player character must protect a girl called Yorda. While the player only directly controls Ico, his actions are very closely tied to leading, guiding and protecting Yorda. One could argue that Ico, in effect, owns Yorda because of the way they are tied to each other.

of games that partially reify the element. Table 1 shows an abridged example of a particular ontology entry called 'To Own'.

The GOP is distinct from design rule and design pattern approaches that offer imperative advice to designers (e.g. Fabricatore et al., 2002). The project does not have as one of its goals to describe rules for creating good games, but rather to identify the abstract commonalities and differences in design elements across a wide range of concrete examples. Also, rather than develop definitions to distinguish between games/non-games or among different types of games (Elverdam and Aarseth, 2007), the GOP focuses on analyzing design elements that cut across a wide range of games. The GOP does not attempt to classify games according to their characteristics and/or mechanics (Lundgren and Björk, 2003), but to describe the design space of games.

The GOP uses prototype theory as an alternative to traditional classification (Johnson, 1985; Lakoff, 1987). Traditionally, things are in the same category if and only if they all have the same properties in common. The GOP has found that for many concepts in games there is no such list of properties that supports a binary category membership function. Thus, many parts of the ontology have fuzzy boundaries regarding what games exemplify them (or have aspects that exemplify them). This is particularly evident in the GOP's use of examples. These examples are important because they help define the center of the category and illustrate the nuances and interpretations an ontological definition may have. The GOP also supports multiple levels of abstraction. In the case of the GOP, entries at the top are generally abstractions and generalizations of those entries beneath them in the hierarchy. Entries at the bottom are generally much more specific.

Authenticity for Learning and Participation as Learning

We will now describe why, in principle, the Game Ontology Project provides students (novices to game studies) with opportunities to learn and acquire a critical vocabulary about games, participate in the creation of new knowledge about games, and also gain

a deeper understanding of games. More specifically, we will describe the learning theory that supports this notion and some of the features of the GOP, and the wiki technology on which it resides, that afford greater participation and learning. Our research questions include wondering in what ways will students be able to use the GOP, will they be able to participate, and will their participation result in meaningful contributions? These questions are meaningful given our knowledge of the fact that students taking games classes are often challenged by their the lack of critical vocabulary for understanding, and describing, what they observe and experience when playing games (Zagal and Bruckman, 2009). We also know that there are many barriers to eliciting participation and collaboration on wiki environments (Guzdial and Carroll, 2002). We argue that, when taken together, the affordances of the GOP and the wiki technology on which it resides, can provide an environment in which expert researchers can effectively collaborate with novices while simultaneously providing a positive learning experience for the latter.

Learning Theory

Learning research has argued the importance of providing students with an authentic context for fostering learning. Authenticity can refer to any of the following: learning that is personally meaningful to the learner, learning that relates to the real world outside school, learning that provides an opportunity to think in the modes of a particular discipline, and learning where the means of assessment reflect the learning process (Shaffer and Resnick, 1999). Shaffer and Resnick note that in their 'thick' view of authenticity, each of these 'kinds' of authentic learning are important, interdependent and mutually supporting (1999). This view of authenticity resonates with the idea that using the tools and methods of a discipline encourages learning in that community of practice (Lave and Wenger, 1991). For example, students should learn history by 'making history' as professional historians do (Kobrin et al., 1993). However, allowing students to meaningfully participate in authentic practices that contribute to a larger body of knowledge is difficult for a variety of reasons. For instance, real-world science is often not accessible to students because authentic activities that are interesting to students are too open-ended and require content knowledge and scientific thinking that students do not have the supports to realize (Edelson, 1998).

If we understand learning as a process of transformation of participation (Rogoff, 1994), of both absorbing and being absorbed in a 'culture of practice', the lack of meaningful connections between novices (students) and larger communities of practice (experts, professionals, and so on) can be problematic. Lave and Wenger (1991) describe how learning occurs through legitimate peripheral participation (LPP). LPP describes how novice members of a community often begin participating in peripheral tasks that contribute to the goals of the community. These activities, while typically simple, are valued and important to the community as a whole (Lave and Wenger, 1991). Thus, how can we design learning environments that: (1) are approachable to novices, (2) allow novices to contribute legitimately to external communities of practice, and (3) support visibility and access to the practices of a broader community?

Game Ontology Project Affordances

The GOP features strong and weak examples as well as a hierarchical approach. By relying on strong, or canonical, and weak or borderline examples, the GOP affords the exploration of the space of game design. Categorizations are not binary, leaving ample room for discussion and revisitation. This implicitly reinforces the notion that the knowledge created in the GOP is not static and certain, but can be improved over time. The ontology's reliance on examples also provides a clear entry point for novices to legitimately and peripherally participate. Novices could leverage their own personal knowledge by adding examples from games with which they are familiar while also refining those entries that already exist. Participating in this way, novices could, in principle, begin to associate what they know about games with the knowledge created in the GOP and identify those things they may know implicitly.

The GOP's hierarchical structure accommodates varying levels of abstraction that can facilitate novice understanding and navigation. Novices may begin by exploring entries that are more concrete (at the bottom), and, as they become more comfortable with the definitions, they can climb the hierarchy exploring those that are more abstract. This provides a natural way to understand the broader context of certain entries.

An important effect of this design is that the knowledge of those who are more advanced does not circumscribe what is to be learned or investigated since novices push discourse towards definition and clarification. In the case of games, not everyone is an expert in every game. Thus, there is room for everyone to provide their own examples and knowledge. Also, the non-static nature of the entries implies that anyone can provide examples that push discourse towards refining and clarifying entries. It is often the case in the GOP that when an entry has too many weak examples, its definition either needs to be refined or a new sub-entry needs to be created for which those weak examples become strong examples. Students using the GOP have the opportunity to interact, contribute and participate directly in an on-going project that is active and used by game studies researchers. They have the chance to truly participate by creating knowledge in an existing community of practice. In summary, for students, the GOP should facilitate:

1 leveraging the use of personal knowledge of games
2 browsing and learning by incorporating varying levels of abstraction
3 an environment focused on discourse where knowledge is continually refined and improved.

Wiki-Related Affordances

The GOP currently resides on a wiki-enabled website. The GOP uses Mediawiki, the same technology used by Wikipedia. Wikipedia's success can be partly explained by certain features normally absent in other wiki implementations. Mediawiki allows registered users to maintain 'watchlists' of pages they wish to pay attention to. Users are notified whenever a page on their watchlist is edited. This feature allows users to 'keep track' of the changes that a page might go through. Another feature is the talk page. Talk pages are secondary webpages, one for each primary page, where users can discuss issues surrounding the topics of the primary pages. Should certain content be added, deleted,

or moved elsewhere? Talk pages provide a space for users to discuss the knowledge they are creating. Also, novices can use these pages to understand the evolution of a page and understand how consensus was achieved regarding its current state.

Wikipedia's success also lies in how it encourages community introspection: it is designed so that members watch each other, talk about each other's contributions, and directly address the fact that they must reach consensus (Viegas et al., 2004). In this sense, novices to the Game Ontology have direct access to the practices, discussions, and reasoning of the game studies researchers that use it. Having the Game Ontology on a wiki-enabled website also provides opportunities for people outside the project to easily participate. There are many legitimate opportunities to participate in the ontology. Not only are there numerous entries that lack depth and examples, but there are also areas that are entirely unexplored. In summary, we believe the technology platform supporting the GOP affords novice participation by:

1 providing separate spaces for content and content discussion
2 providing visibility of the discussions and process behind the creation of content
3 helping users keep track of content in which they are interested or involved.

Study

In early 2007, the Game Ontology was used as part of the regular activities in an introductory undergraduate game design class at a non-local university. It was a lecture-style class with over 200 students and was taught by an instructor who was neither involved in the GOP nor part of the research study we conducted. In the class, students were required to play and design games, read scholarly articles, and turn in written assignments. Participants were recruited at the beginning of the term, and 49 students chose to participate and contributed to the ontology. Given our interest in characterizing the situation and context in which learning would take place (as opposed to controlling variables), we decided to focus on a design-based research approach (Barab and Squire, 2004; Brown, 1992; Collins, 1992). Rather than focus on outcomes, we wanted to examine the naturalistic setting in which we expected learning to take place. We also anticipated interacting with students as experts in the GOP community and foresaw the possibility that changes to the GOP might happen alongside the students' participation. Perhaps more importantly, the goal of our research was to lay open and problematize the completed design and resultant implementation of the learning experience in a way that provides insight into the local dynamics. The form of our article, with rich narratives and descriptions of our participants' perceptions, is designed to aid the reader in particularizing the findings from our study to their own setting (Firestone, 1993).

Our research also raised ethical issues we needed to address. For example, educators should take care to protect their students' rights to privacy regarding their course assignments and grades. In our case, students would be required to participate in a public online environment that is largely beyond the control of the course instructor. This raises the issue of balancing the need for privacy with the importance of allowing students to take credit for their legitimate contributions on a public site. With this in mind, students were instructed to take care not to reveal personally identifying information and to register on the GOP using pseudonyms. However, if they desired, they could 'out'

themselves by adding personal information on their user page. We also made sure that the students understood that the course instructor and class teaching assistants were involved with neither the GOP nor the research study we were conducting. We wanted to avoid students misconstruing their participation in the GOP as 'grunt work' for their instructor. Students were also informed that their participation would be evaluated, but not the quality of their contributions to the ontology. This evaluation was performed by the class 'teaching assistants'.

Data Collection and Analysis

As part of their regular coursework, students were introduced to some terminology from the GOP. Three weeks later students were asked to complete a Game Ontology assignment. For the assignment, students had to pick two games they knew well. Then they had to find entries in the ontology and edit them in such a way as to add those games as examples (strong or weak). Students had to edit at least two entries. The only additional restriction was that at least two of the examples should be added to entries under the 'Rules' sub-hierarchy.

Students were graded only on the completion of the assignment. Because it is often the case that disagreements about examples have led to the refinement of the ontology, grading did not focus on their 'correctness'. Additionally, students were offered the possibility of extra credit for participation that went above and beyond the assignment requirements, such as meaningful contributions to existing entries, proposing new entries, and participating in discussions on the talk page. The researchers were not involved in the assessment, though they did participate in the discussions that took place on the ontology wiki pages. While the study took place, the ontology remained open to 'outsiders' who could freely read and edit, any of the entries in the ontology. However, no changes were made to student-modified entries during this time either by experts or 'outsiders'. The duration of the assignment was officially one week, though students could begin their participation sooner.

In all, 381 edits were made to the ontology by study participants. Edits varied from minor (one or two characters, such as when correcting a typo) to one or two paragraphs in length. In total, 65 different ontology entries were edited, and participants contributed a total of 128 different examples. On average, each student contributed 4.2 examples with a standard deviation of 1.01. Additionally, we conducted interviews with 16 students, 3 of the teaching assistants, and the instructor. As recommended for qualitative research (Glaser and Strauss, 1967), we employed theoretical sampling in which cases are chosen based on theoretical (developed a priori) categories to provide polar types, rather than for statistical generalizability to a larger population (Eisenhardt, 1989). Interview subjects were selected based on their level of prior experience with games (novice, intermediate, gamer) and participation on the GOP (none, minimum required, active participation). All interviews were audio-recorded and transcribed. Our interview protocol included questions about the students' experiences participating in the ontology and also open-ended questions about their expectations regarding the course and changes they would make to the assignments. Interviews were semi-structured to ensure that all participants were asked certain questions yet were still allowed to raise other issues they felt were relevant. Data from the interviews were used to contextualize and provide insight

to the analysis of student participation. For instance, if a student made many changes, how would we interpret them adequately? Did a student write about an obscure game because it was personally meaningful or simply because it happened to be the last one played? Was the student confused about the assignment or did he or she have difficulties with the website interface? Did they choose to add examples based on perceived gaps in the knowledge on the site or simply based on what came to mind? We also wanted to have a sense of participants' thoughts and feelings during their participation. Did they feel part of a broader community (rather than doing an 'assignment')? Did they feel valued in their contributions? Insight into the process, attitudes, and experiences students went through would help us produce in-depth and complex understanding. The principal drawback of this approach is a lack of statistical generalizability of our findings. All interviewee names appearing in this article have been changed for reasons of privacy.

We also analyzed the quality of contributions made by the students. Three subject-matter experts evaluated a random selection of examples written by the students. The experts were selected because of their prior experience as researchers on the Game Ontology Project. The goal of this evaluation was to determine the value of the student's' contributions, in other words, should they remain in the ontology? In the case of examples that were edited multiple times, the experts analyzed the most current version as written by the study participant. Our experts analyzed a randomly selected sample of two-thirds of the examples written by study participants (96 out of a total of 128). This was a convenience sample we felt adequately represented the contributions made by students and all of the students' work was represented in the sample studied. Each expert independently reviewed 32 different examples. For purposes of calculating interrater reliability, a separate random sample of 10 examples (10% of the sample size) was independently evaluated by all three experts. As recommended by Lombard et al. (2002), two indices were selected to determine interrater reliability. In terms of percentage of agreement, two of the three raters agreed 100 per cent of the time and all three agreed 60 per cent of the time. Fleiss's kappa (1971) was calculated as 0.87 ($p < 0.01$). A review of 'rules of thumb' set out by several methodologists notes that, 'coefficients of 0.90 or greater would be acceptable to all, 0.80 or greater would be acceptable in most situations, and the criterion of 0.70 is often used for exploratory research' (Neuendorf, 2002).' More liberal criteria are usually used for the indices known to be more conservative, such as Fleiss's kappa (Lombard et al, 2002). Thus, in the case of this research, a value of 0.87 is considered acceptable.

Samples of Student Participation

In order to provide a better context for the type and form of the student's' work, we now present and briefly discuss two contributions made by different students for the same Game Ontology entry. One example was evaluated positively by the experts and the other was not. Our goal is not to comment on the insight, quality, or general correctness of the contributions. Those issues will be discussed later in the context of the experts' analysis.

Checkpoints

Checkpoints, as defined in the ontology,

> *are specific (non random and predetermined) places or moments in a game wherein a player is not forced to start completely over if he or she were to lose a chance. This, of course, only applies to those games where the loss of a chance implies having to begin anew (instead of continuing at the place and moment in which the chance was lost). The use of a checkpoint enables the player to start automatically at the checkpoint that is closest to the ending and has been activated or visited. Different games have different mechanisms for the 'activation' of checkpoints. Checkpoints are usually activated simply by reaching them or by explicitly interacting with an object that represents the checkpoint within the level. Each level can have multiple checkpoints.*

The Checkpoint entry is a low-level entry (i.e. it has no children) and its parent entry is Gameworld Rules.

The following example describes how checkpoints have been implemented in *Super Mario World 2: Yoshi's Island*. The example notes how this implementation has additional effects on gameplay (i.e. 'give 5 extra seconds') that are not considered in the original Game Ontology definition. This entry was evaluated positively by the expert reviewers, although parts of it might need to be rewritten for clarity and brevity.[2]

> *Super Mario World 2: Yoshi's Island is a strong example of the checkpoint system. During the levels players encounter 'star hoops', which once jumped through, save the player's position in the level at that point. If you die, you are brought back to this point, and there are mutiple star hoops throughout each level which save you place as long as you jump through them. These hoops also increase you star number, or the amount of time you have to retrive the crying baby mario (a clock counts down when you are injured and mario has been displaced, indicacting how many seconds you have to retrive him or essentialy lose a life and start over) – Once you jump through the hoop you are give 5 extra seconds to this time, but only once. So if you die, or lose baby Mario, you are still brought back this spot in the level. It is possible to play past levels, but previous completions of a level do not affect where you star out in the level. (Super Mario World 2: Yoshi's Island – strong example)*

In the next example, presented as a weak example, the author argues that *Tekken 5* does not really have checkpoints. The author describes what happens when the player-controlled character dies, and notes how this is different from the definition of checkpoint. This example was not evaluated positively by the expert evaluators, though it was noted that this example drew the expert to think about improvements that could be made to the Game Ontology entry.

> *There are no real checkpoints in the main game because when a character dies during the arcade mode, they are just prompted to press start before the timer runs out and that person has another go at the stage where they died on. These 'Continue?' screens are not a checkpoint because they can appear anywhere along the way in arcade mode and not in specific locations as there are no real locations in the game. (Tekken 5 – weak example)*

Results

We now present and analyze the results of our study in the context of the questions posed earlier. First, we discuss the effects and perception of the novices (students) regarding their participation in the GOP. In other words, (RQ1) was the GOP approachable to

novices and (RQ3) did it support visibility and access to the practices of the game studies researchers who use it? Then, we discuss the merits of the novice's contributions and the effects that their participation had for the experts. In other words, (RQ2) did the GOP allow novices to contribute legitimately?

Overall Effects and Student Perception

In general, the students were positive about the role they felt the GOP played in the context of the class. Anne felt that 'it was a good assignment because it really made you think and try and really think about the aspects of the games you had played'. For the majority of the students, the ontology was a source of definitions. Bert describes how 'there were a lot of times where [the instructor] would just be rattling away all these terms, and I would be a little bit scared in my seat, and I would write down what I didn't understand, and I would go home and check it out'. Many of these students didn't perceive the GOP as a 'living' source with definitions that could be debated, edited and improved. On the other hand, some students found that using the GOP broadened their understanding of games. Frank noted that 'I didn't really think about games along those terms before, and it was nice to have a new perspective on games'. Understanding games as the combinations of structural elements of gameplay was novel to them. Anne comments that she 'thought the categories were really interesting. I hadn't thought about the breakdown of games before, so I really liked that.' Finally, some students felt it was helpful to them in the context of their game design projects. Joe felt that 'when you're making a game, there a lot of choices you have to make, and knowing your options made your choices clearer'.

Other studies have shown that even though online resources may be public, they will not necessarily be perceived as public by those using them (Forte and Bruckman, 2006). This was not the case in our research. Students realized that their participation on the ontology would be visible to people outside of the class as well as the games researchers who regularly worked on the ontology. They realized they were making changes and adding content to a public resource, and that their work had consequences beyond the assignment. In this sense, the assignment was an authentic and legitimate activity. Mary noted that 'I was sort of worried about putting something in that wouldn't fit because it is an editable site, and so I would put something in, and it would be like . . . oh that's really wrong, I'm going to mess things up for the game researchers'. Mike, on the other hand, described his concern regarding the correctness of his examples because 'if somebody were to have put things in categories that they didn't belong, and they weren't corrected, then they might have learned the opposite of what's true'.

Supporting Deeper Understanding

Student participation in the GOP also afforded a deeper understanding of videogames. We found evidence of students situating, describing, and contextualizing games with respect to other games and the technology on which they are implemented. We also found evidence of students identifying and deconstructing the components of games and understanding how they relate to each other. As we will explain later, the use of strong and weak examples was especially productive.

In the following example, the novice contributor argues that *Randomness* (an entry in the GOP) is present in *Baldur's Gate* in the way that attacks are resolved. The example notes that the rules system of *Baldur's Gate* is based on another game whose attacks are resolved by rolling dice. The author of this example is demonstrating an understanding of aspects of *Baldur's Gate* in context with other games.

> *In the computer role-playing game Baldur's Gate, the success of a player character's attack is determined probabilistically by rolling a 20-sided dice. Since the rules-system is based on a well-known paper and pencil role-playing game (Dungeons and Dragons), it can be assumed that the players are aware of the probabilities involved. (Baldur's Gate – strong example)*

We hypothesized that using strong and weak examples would prompt students to reflect on games at a deeper level.

> *It was really challenging to come up with specifically strong and weak examples of things because there were some of them that you could come up with gray areas for. In Oblivion, depending on which version of the game you have, you may get a strong ending or a world exhaustion [referring to the entry Game Ends and its child entry Gameworld Exhaustion], because if you have the PC version you could download more pieces or more modules to increase your game time, and those are all part of the world. So in a sense, the world never really ends. (Tom)*

The use of strong and weak examples in the Game Ontology helped some students think more deeply about the entries and how they relate to what they see in certain games. As will be discussed when we look at the experts impressions of student contributions, students generally achieved a nuanced understanding of games. While coming up with strong examples was considered easy by most students, having to identify weak examples and justify their reasoning elicited greater reflection and discussion. Tom's example is also illustrative of how he begins to understand games more deeply. Tom began to consider *Oblivion* in the context of the technology on which it was implemented. Here he comments on how the platform on which the game is executed changes the game. Orville also commented how participating in the Game Ontology made him consider these issues, 'I found it interesting that it wasn't just about the software. It was also about the interface and the hardware which I found is an integral part of the game experience. I hadn't thought about that.'

In the following weak example for the entry *Lives*, the novice contributor explains how in *Legend of Zelda: A Link to the Past* there is a health system that is not represented like other games that have strong examples of *Lives*. However, there is a non-central game mechanic, capturing a healing fairy in a bottle, which is functionally similar to how *Lives* work. This example highlights how achieving a deeper understanding of games entails more than just identifying components, but actually understanding how they work and what role they play. In the following example, there is a functional, rather than representational, similarity, thus making for a valuable and insightful example in the Ontology.

> *In Legend of Zelda: A Link to the Past, fairies have healing powers. 'Touching' a fairy will restore some of Link's hearts [the player controlled character], but the fairies can also be captured by use of the bee net. If Link possesses an empty bottle, the fairy can be stored in the bottle for later release/use as normal. Additionally, if a bottled fairy exists in Link's inventory upon depletion of hearts, Link will die, but be immediately resurrected with half of his maximum hearts filled, and*

gameplay continues. If no fairy is present, the player must reload from a save point. This is a weak example of Lives because Zelda does not have an explicit representation of this concept, the hearts representing Link's health in a similar fashion to Half-Life's health bar. However, when the player has captured a fairy and dies, the resurrection is functionally very similar to what happens in regular games with lives. In this sense, the fairy in the bottle is equivalent to Link having an extra 'life' stored away. (Weak example)

Challenges

There are many barriers to eliciting participation and collaboration on wiki environments (Guzdial and Carroll, 2002), and our study was not an exception. Many students were not familiar with wikis and the features offered by Mediawiki. Some students did not understand that, regardless of their activity, the wiki site still contains all the information necessary for grading the assignment. When asked why he didn't edit other people's contributions, Chris comments that 'if somebody had put that there, and that was their contribution, then it might not be a good idea to move it for the sake of their grade. If I moved it, it would look like they didn't put something.' Forte and Bruckman (2007) have noted that instructors can find it challenging to assess collaborative wiki work. Thus, it may also be possible that students believed that removing content from a page would affect the teaching assistants' ability to grade the assignments. Also, having one assignment may have limited the possibilities of students engaging more with the discussions surrounding the entry definitions and value of certain examples. For many students, completing the assignment was an issue of 'fire and forget', as there was little incentive to return to the ontology, read what their classmates may have added and possibly refine knowledge created on the site.

A broader issue is how to help students move from viewing knowledge as static and 'given' to something that they can help create and define. Students had difficulties articulating the distinction between becoming familiarized with the vocabulary, ideas, and concepts in the ontology and realizing they were participating in refining or defining those same concepts. When asked whether he considered making changes or edits to an entry, and not just adding examples, Joshua recalls 'I hadn't thought of that. I guess people could, but then you wouldn't have these standard terms, right?' Kyle also brought up the issue of standardization and positioned his participation in the Game Ontology as one that should reinforce, rather than challenge the status quo of existing definitions, 'it's interesting that you standardize terms and that you have specific examples for each term and I guess that we [the students] come in to help shore up the walls or fill in the blanks'. There are alternative hypotheses that might explain students' views of the ontology as static. One is that the way in which the ontology was presented to students may have misled them into assuming a static view of knowledge. The fact that the students were participating in an assignment for a class may have played a role in this. In this case, the traditional identity of a student who 'acquires' knowledge may have been at odds with the identity of a 'participant' who is situated in a practice through which he creates knowledge with others (Sfard, 1998). Finally, students might have viewed their participation in the GOP as peripheral and that, since they were not central members of the project, they were not qualified, or ready, to participate more centrally.

Contribution to Game Studies

The expert evaluation of the examples written by the students was quite positive. The experts determined that 60 per cent of the examples should remain in the ontology while only 14.5 per cent should be removed (see Table 2). For the remaining examples (25.5%), the experts were ambivalent. Most of the examples, including those the experts were ambivalent about, could benefit from further proofreading and editing. Others could be improved with information that better contextualizes the example with respect to the entry where it appears. For instance, one expert notes, for an example added to the 'Boss Challenge' entry (see Table 3), '[I] would like a little more detail on the structure of the "town" and "gym leader" situation for those of us who are Pokémon-challenged. I'm guessing you fight people in the town and work your way up to the "gym leader" boss.' Other examples could benefit from the removal of unnecessary commentary or editorial such as the opinion of the relative merits of a game over its sequel. The expert reviewers also found some examples (10% of all examples) that should be changed from strong examples to weak examples or vice versa.

Few examples were considered 'non-salvageable' (only 6% of all examples) because they were incorrect or did not apply to the particular ontology entry where they were included. More than half (56%) of the examples evaluated as 'should be removed' were considered relevant, but not worth the effort to correct. One of the experts noted, 'Sometimes the students didn't seem to find the right words and simply explained the examples very poorly. I found 2 types of "bad" examples, the least of these were those that were not relevant. Most were relevant but poorly explained.'

When characterizing the contribution made by the students' examples, perhaps the single most common feature was that the examples helped add variety to the ontology entries in which they appeared (58% of all examples). Of the examples that added variety, 79 per cent refer to a game that many people have played or know about (46% of all examples). When trying to understand an entry, it helps to have a variety of examples that refer to well-known or popular games because people are more likely to find a game they can relate to their personal experiences. This makes the entry more accessible. Variety

TABLE 2

Expert evaluation of student contributions

Expert Evaluation	Percentage
Example should remain in the ontology	60
Ambivalent about permanence or removal of example	25.5
Example should be removed from the ontology	14.5

TABLE 3

User submitted example lacking enough detail

Boss Challenge (Pokémon)
Pokémon is a strong example of a game with Boss Challenges. Usually in every town, the player must defeat the gym leader. Each gym leader has different types of Pokémon such as Water or Fire and different strategies are necessary for defeating each one.

was also increased through the addition of examples that refer to games that are unusual or rare, yet still important for people to know about. This was the case of 21 per cent of the examples that added variety (12% of all examples). Examples that refer to unusual or rare games can help to broaden students' understanding by drawing attention to games they might not have heard about or considered playing otherwise. Many of these 'rare' games are interesting, from a game studies perspective, because they can help illustrate the nuances and varying interpretations that an ontological entry can have (Zagal et al., 2007).

The majority of the examples provided by the students served simply as contributions to the body of knowledge that is the game ontology (see Table 2). But some students' examples also contributed to the field. The expert evaluators noted that some examples (5%) helped them realize something they had not noticed or thought about previously. One expert commented 'I wasn't expecting to find examples of that entry from that particular genre of games. I wasn't really aware of how that genre had evolved and I guess I should play some more!'

Also, 9.1 per cent of the examples helped the experts notice something about the ontology entry that needed to be improved or expanded upon. For example, in the entry 'Games Ends', one of the students added a weak example referring to the game *Pac-Man*. *Pac-Man*, in theory, does not have a formal ending (you can't win, it just gets harder and harder until you lose). However, there is a technical issue that causes the game to crash when the player reaches the 256th screen (Sellers, 2001). The student-provided example draws attention to an issue that was not considered in the original entry (game ends due to technical issue) and made the expert wonder if the entry should be modified to account for this. Another example, for the ontology entry *Agent Goals*, made an expert realize an implicit bias in the entry. 'The way the entry is written, it sounds like we're talking about states in state machine AI. What we're getting at in the end here is that AI-controlled agents have a prioritized set of goals that they seek to fulfill (like a hierarchical goal tree and the agents can switch modes between those goals according to the hierarchy of the goal tree)?' The entry, as written, implicitly assumes certain details about how agent goals are implemented in videogames and the expert wonders whether or not to leave the entry with that bias.

Student examples also served as a catalyst for reflection on broader issues of the Game Ontology. Experts indicated that 2.7 per cent of the examples helped them think about something that should be added to another part of the ontology. For instance, an example referring to the game *Katamari Damacy* was added to the entry *To Remove*. In this game, the player controls a large sticky ball. As the ball rolls over things these become stuck to it, causing it to grow, thus being able to roll over larger items, and so on. The game maintains a record of everything a player has ever rolled over across all of his play sessions. The expert noted that this was an interesting case of in-game/out-of-game interactions. This is something the expert felt has not really been addressed directly in the Ontology. These examples drew attention to future areas of growth for the ontology, including new directions to pursue or new entries that should be added. In other words, student participation should not be perceived as 'filling in the blanks', it also helped propel experts' thinking in new directions.

In summary, we are confident in stating that the students' contributions to the ontology were not only useful to them, pedagogically speaking, but can also be fairly

characterized as legitimate contributions to a body of knowledge that is part of the academic field of game studies.

Discussion

One of the challenges for this study was answering how to make the GOP, and the terms and concepts it describes, approachable and useful to students. We also wanted to help students leverage their knowledge about videogames. From that perspective, this experience was a success. Many students participated beyond the minimum requirement. In all, 28 per cent of the students used more than two games and 34 per cent edited more than four ontology entries. The GOP was approachable by the students, and they also felt it played an important role in their games education. Fran describes, 'If you're going to study game design, it's important to have standardized terminology. I think that with the game ontology wiki it's interesting that you standardize terms and that you have many specific examples for each term, and that's very important in terms of understanding the different parts that make a game or different aspects from different games.' We also wondered if the student contributions would be meaningful, or useful, to the game ontology project itself. On this point, we feel that we have succeeded in providing a learning environment where students legitimately contributed to an emergent field of study. The combination of the domain of study with specific avenues of participation allowed many students to situate their activities on the GOP with their identities as game players. These avenues provided ways for students to deal with Wenger's duality of identification and negotiability (Wenger, 1998). Wenger refers to identification as that which provides experiences through which individuals can build their identities via 'relations of association and differentiation'. By legitimizing learner's knowledge, we helped them assess the extent to which they can 'identify' with the mutual enterprise, culture, and history of the GOP's community. Negotiability refers to 'the degree to which we have control over the meanings in which we are invested' (Wenger, 1998). Negotiability includes how an individual perceives his or her ability, facility, and legitimacy to contribute to and take responsibility for the direction of a community of practice. In our case, this highlights reasons for exploring why some students misperceived the Game Ontology as a static and monolithic source. We wonder if having students provide examples only reinforced the definitions provided in the ontology rather than encouraging them to challenge those definitions. Student-provided examples helped the subject-matter experts reflect and think in new directions; this is something that ideally the students should also engage in. Further work is required to look at how to achieve the delicate balance between reinforcing and building upon existing ideas and challenging the status quo in such a way as to promote new ideas. Also, it is not clear to us how many students participated less because of concerns of 'messing things up'. In this sense, the legitimacy and authenticity of the assignment may have acted as a barrier to participation.

Technology innovations designed to foster deep learning and thinking should address issues of sustainability and usability (Fishman et al., 2004). Our intervention is not an exception. Are the positive results of this experience the result of students taking advantage of 'low-hanging fruit'? If we were to repeat this experience, how many entries would become saturated with too many similar examples that only marginally help to illustrate

an entry? This concern can be addressed by changing the structure of the Game Ontology to support larger numbers of examples or by providing users with tools to filter the information provided. Users could filter an entry so as only to display examples for a certain hardware platform or games released after a certain year. However, the nature of the medium helps mitigate the 'too many examples' problem. Older games are frequently unknown to younger students and are also often inaccessible for market reasons or hardware obsolescence. The Game Ontology Project will always need to update its examples to remain accessible and understandable to its users while also allowing new games to force the re-evaluation of existing entries.

Conclusions

Our experience shows how participating in an ongoing research project by building new knowledge can be used as a way to help students establish connections between their knowledge and the concepts and ideas developed as part of the research project. By participating in an ongoing project, students could also gain visibility into creating knowledge as a way of understanding, and creating new understanding. However, the experience of adding new knowledge and participating in a knowledge-building enterprise contrasts with the evidence we found supporting the notion that students perceived the ontology as a static source. One possibility is that students viewed their participation in the GOP as peripheral and that, since they were not central members of the project, they felt they were not qualified or ready to participate more centrally. Students may have perceived that proposing and editing ontology entries was an activity better left to 'the experts'. It is also possible that the 'school' context misled students into assuming a static view of knowledge. As Barab and Duffy (2000: 36) describe, 'all too frequently, school culture accords knowledgeable skill a reified existence, commodifying it, and turning knowledge into something to be "acquired"'. Further research is needed to understand better whether or not this experience was isolated and what role the object of study (games) and the structure of the assignment may have played.

We have shown how we can support an emergent field in defining the language and vocabulary necessary to developing a common understanding of its objects of study. We can do this by allowing novices in the field to participate in knowledge building with experts and also contribute to the growth of the field. However, we do not know in what ways this result depends on the field of game studies' relative youth. Some of the factors that played an important role in this experience include the degree of established theory of the field, the relative experience of the experts, the knowledge and experience of novices with regard to the subject matter, and the personal relevance of the subject matter to the novices' lives. In the case of game studies, we have a field with little established theory concerning subject matter that is close and personal to novices' lives. Game studies is thus, as a discipline, 'close' to the average student. This 'closeness' makes it easier to create spaces of shared discourse where new understandings can be created. There is no reason to believe that 'closeness' cannot be developed for other disciplines. In fact, this would seem to be one of the main challenges, making a discipline and its knowledge relevant or relatable to students. We feel that our approach offers a model for how to do new media education in a manner that reflects the underlying values of the content.

More broadly, we argue that although discussing, leveraging, and creating ties between novices and a community of practice can be beneficial for novices, it should also benefit the community of practice. The community of practice should benefit from the contributions made by the novices and, indirectly, from the greater ties and connections that are established with its potential future members. The community of practice also benefits from the greater, and stronger, ties it may create with a broader sociocultural environment. In the same way that the Samba schools of Brazil are successful learning environments through the tight dialogue they maintain with Brazilian culture and society (Zagal and Bruckman, 2005), emergent fields can be supported by helping them establish these closer ties, provide broader mechanisms for legitimate participation, and allow for greater diversity of its participants.

The Game Ontology Wiki is an example of this kind of support. This is, perhaps, where the key to supporting understanding and learning may lie. We know that learning rarely happens in isolation, and, in a sense, learning is about removing isolation. Learning is about establishing links and bridges. In the case of games, we have discussed the challenges of making connections between personal experiences with games and abstract concepts and ideas. However, perhaps one of the more valuable links is that between experts and novices.

In summary, our experience shows that it is possible to design learning environments that are approachable by learners, allow them to contribute legitimately to external communities of practice, and support visibility and access to the practices of a broader community. However, it is important to consider carefully not only the affordances of the technology but also the practices of the broader community in which students will participate. Navigating these issues is crucial so that students may effectively engage in practices meaningful to them as well as the broader community.

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Notes

1 RQ = research question.
2 Quoted text is presented as written.

References

Barab, S. and Duffy, T. (2000) 'From Practice Fields to Communities of Practice', in D. Jonassen and S. Land (eds) *Theoretical Foundations of Learning Environments*, pp. 25–56. London: Lawrence Erlbaum Associates.

Barab, S. and Squire, K.D. (2004) 'Design-Based Research: Putting a Stake in the Ground', *Journal of the Learning Sciences* 13(1): 1–14.

Benkler, Y. (2006) *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. New Haven, CT and London: Yale University Press.

Brown, A.L. (1992) 'Design Experiments: Theoretical and Methodological Challenges in Creating Complex Interventions in Classroom Settings', *The Journal of the Learning Sciences* 2(2): 141–78.

Bryant, S., Forte, A. and Bruckman, A. (2005) 'Becoming Wikipedian: Transformation of Participation in a Collaborative Online Encyclopedia', in *Proceedings of GROUP International Conference on Supporting Group Work*, Sanibel Island, Florida, pp. 1–10. New York: ACM.

Collins, A. (1992) 'Toward a Design Science of Education', in E. Scanlon and T. O'Shea (eds) *New Directions in Educational Technologies*, pp 15–22. New York: Springer-Verlag.

Edelson, D. (1998) 'Realizing authentic science learning through the adaptation of scientific practice', in B.J. Fraser and K.G. Tobin (eds) *International Handbook of Science Education*, pp. 317–31. Dordrecht: Kluwer.

Eisenhardt, K.M. (1989) 'Building Theories from Case Study Research', *Academy of Management Review* 14(4): 532–50.

Elverdam, C. and Aarseth, E. (2007) 'Game Classification and Game Design: Construction Through Critical Analysis', *Games and Culture* 2(1): 3–22.

Fabricatore, C., Nussbaum, M. and Rosas, R. (2002) 'Playability in Action Videogames: A Qualitative Design Model'. *Human Computer Interaction* 17(4): 311–68.

Firestone, W.A. (1993) 'Alternative Arguments for Generalizing From Data as Applied to Qualitative Research', *Educational Researcher* 22(4): 16–23.

Fishman, B., Marx, R.W., Blumenfeld, P.C. and Krajcik, J.C. (2004) 'Creating a Framework for Research on Systemic Technology Innovations', *Journal of the Learning Sciences* 13(1): 43–76.

Fleiss, J.L. (1971) 'Measuring Nominal Scale Agreement Among Many Raters', *Psychological Bulleting* 76: 378–82.

Forte, A. and Bruckman, A. (2006) 'From Wikipedia to the Classroom: Exploring Online Publication and Learning', in S. Barab, K. Hay and D. Hickey (eds) *Proceedings of the 7th International Conference of the Learning Sciences Bloomington, IN, Vol. 1*, pp. 182–8. International Society of the Learning Sciences.

Forte, A. and Bruckman, A. (2007) 'Constructing Text: Wiki as a Toolkit for (Collaborative?) Learning', in A. Desilets and R. Biddle (eds) *Proceedings of the OOPSLA/ACM 2007 International Symposium on Wikis (WikiSym) Montreal, Quebec, Canada*, pp. 31–42. New York: ACM.

Glaser, B. and Strauss, A. (1967) *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago, IL: Aldine.

Guzdial, M. and Carroll, K. (2002) 'Explaining the Lack of Dialogue in Computer-Supported Collaborative Learning', in G. Stahl (ed.) *Proceedings of the International Conference of the Learning Sciences*, pp. 425–34. Mahwah, NJ: Lawrence Erlbaum Associates.

Hung, D. and Nichani, M. (2002) 'Differentiating between Communities of Practices (CoPs) and Quasi-Communities: Can CoPs Exist Online?', *International Journal on E-Learning* (July–September): 23–9.

Jenkins, H. (2006) *Fans, Bloggers, and Gamers*. New York: New York University Press.

Johnson, C.M. (2001) 'A Survey of Current Research on Online Communities of Practice', *Internet and Higher Education* 4(1): 45–60.

Johnson, R.K. (1985) 'Prototype Theory, Cognitive Linguistics and Pedagogical Grammar', *Working Papers in Linguistics and Language Training* 8: 12–24.

Kobrin, D., Abbott, E., Elinwood, J. and Horton, D. (1993) 'Learning history by doing history'. *Educational Leadership* 50(7): 39–41.

Lakoff, G. (1987) *Women, Fire, and Dangerous Things: What Categories Reveal About the Mind*. Chicago, IL: The University of Chicago Press.

Lave, J. and Wenger, E. (1991) *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.

Lombard, M., Snyder-Duch, J. and Companella, C. (2002) 'Content Analysis in Mass Communication: Assessment and Reporting of Intercoder Reliability', *Human Communication Research* 28(4): 587–604.

Lundgren, S. and Björk, S. (2003) *Describing Computer-Augmented Games in Terms of Interaction*. Technologies for Interactive Digital Storytelling and Entertainment (TIDSE), Darmstadt: Germany.

Neubauer, S. (2006) *The Gameplay Video Segmentation Method*. Stuttgart: Stuttgart Media University 97.

Neuendorf, K.A. (2002) *The Content Analysis Guidebook*. Thousand Oaks, CA: SAGE.

Rogoff, B. (1994) 'Developing Understanding of the Idea of Communities of Learners', *Mind, Culture, and Activity* 1(4): 209–29.

Roth, W.M. (1998) *Designing Communities*. Dordrecht: Kluwer Academic Publishers.

Schwen, T.M. and Hara, N. (2003) 'Community of Practice: A Metaphor for Online Design?', *The Information Society* 19(3): 257–70.

Sellers, J. (2001) *Arcade Fever: The Fan's Guide to the Golden Age of Videogames*. London: Running Press.

Sfard, A. (1998) 'On Two Metaphors for Learning and the Dangers of Choosing Just One', *Educational Researcher* 27: 4–13.
Shaffer, D.W. and Resnick, M. (1999) '"Thick" Authenticity: New Media and Authentic Learning', *Journal of Interactive Learning Research* 10(2): 195–215.
Squire, K.D. and Johnson, C.B. (2000) 'Supporting Distributed Communities of Practice with Interactive Television', *Educational Technology Research and Development* 48(1): 23–43.
Viegas, F., Wattenberg, M. and Kushal, D. (2004) *Studying Cooperation and Conflict between Authors with history flow Visualizations*. CHI 2004, Vienna, Austria.
Viegas, F., Wattenberg, M., Kriss, J. and van Ham, F. (2007) 'Talk Before you Type: Coordination in Wikipedia', in *Proceedings of the 40th Annual Hawaii International Conference on System Sciences*, p. 78. IEEE Computer Society.
Wenger, E. (1998) *Communities of Practice*. Cambridge: Cambridge University Press.
Wenger, E. (2001) 'Supporting communities of practice: A survey of community-orientated technologies' (version 1.3). From URL (accessed 17 September 2008): http://www.ewenger.com/tech
Zagal, J.P. and Bruckman, A. (2005) 'From Samba Schools to Computer Clubhouses: Cultural Institutions as Learning Environments', *Convergence* 11(1): 88–105.
Zagal, J.P. and Bruckman, A. (2009) 'Novices, Gamers, and Scholars: Exploring the Challenges of Teaching About Games', *Games Studies: The International Journal for Computer Games Research* 8(2). Online journal, URL (accessed 2 July 2010): http://gamestudies.org/0802/articles/zagal_bruckman
Zagal, J.P., Mateas, M., Fernandez-Vara, C., Hochhalter, B. and Lichti, N. (2007) 'Towards an Ontological Language for Game Analysis', in S. de Castell and J. Jenson (eds) *Worlds in Play: International Perspectives on Digital Games Research*, pp. 21–35. New York: Peter Lang.

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