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Author	Yam San Chee
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Game-Based Learning as Performance: The Case of Legends of Alkhimia

Yam San Chee

Nanyang Technological University, Singapore

yamsan.chee@nie.edu.sg

Abstract: The evaluation of learning outcomes associated with game-based learning is fraught with conflict and confusion. Many serious game developers uncritically use content mastery as the yardstick of learner progress and achievement. Other developers train simple skills in a drill-and-practice fashion in the belief that games are best used to motivate student interest in subject domains that students find boring or tedious to learn. This paper has two parts. The first part is theoretical, and the second part consists of an illustrative case. In the first part, I examine computer and video games as a unique digital medium that supports *first-person* immersive learning. I interrogate what kind of epistemology is entailed when learning takes place in the first-person. Drawing upon the philosophy of pragmatism, I argue that a powerful and appropriate way to assess game-based learning outcomes using such games is through the construct of *performance*. This construct is grounded in the literature related to performance theory and performance studies. A performative stance, I argue, is productive for viewing learning through the theoretical lens of *being* and *becoming* because game play involves *being* a person on a developmental trajectory of *becoming*. Locating learning within a socio-cultural context, I show how the construction of identity has a vital role to play in a performance-oriented theory of learning. In the second part of the paper, I reify the theoretical ideas above via the educational game “Legends of Alkhimia” (LoA). This game has been developed at our research centre. It will be used in two classrooms, in separate schools, in mid-2010. LoA is a multiplayer game that supports up to four concurrent users. The game is designed to support authentic learning of chemistry by 14-year-olds at the lower secondary school level. The underlying pedagogy is one of learning as inquiry, in the spirit of Dewey. Dialogism and the enaction of identity are key elements of the curriculum’s learning design. In the LoA game, students have to solve the mystery of recent strange happenings in the once sleepy town of Alkhimia. In tackling this challenge, students engage in *doing* chemistry to create effective weapons that can repel marauding monsters that appear out of nowhere, and they work to fulfil missions for the good of various inhabitants of the town. They slowly become acquainted with the legends of Alkhimia and learn that not all is as it appears. By engaging in the learning program, the goal is that students will develop a practical sense with and of chemistry as a professional domain of practice. In so doing, they appropriate the *habitus* of professional practice and develop the values and dispositions of critical reflexivity and epistemological vigilance. In short, they learn to *become* chemists.

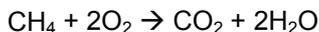
Keywords: performance, identity, values, becoming, inquiry

1. Introduction

The evaluation of learning outcomes associated with game-based learning is fraught with conflict and confusion. Many serious game developers uncritically use content mastery as the yardstick of learner progress and achievement. This orientation may have its roots in Prensky’s (2001) seminal book on digital game-based learning. In this book, Prensky argued that “[t]he premise behind Digital Game-Based Learning is that it is possible to combine computer video games with a wide variety of *educational content*, achieving as good or better results as through traditional learning methods” (pp. 145–146; italics added). Positioning education as the mastery of content leads, unfortunately, to an extremely restrictive notion of what education might be. This positioning also succumbs to Postman and Weingartner’s (1969) critique of a typical school lesson as comprising two components: content and method. Content is thought of as the “substance” of a lesson. It has prior existence to and is independent of the student. Content is something that students are supposed to “get.” Method constitutes the manner in which the content is presented. Based on this restrictive notion of education, games are reduced to a medium for conveying content. A typical example that illustrates this approach can be found at the website sheppardsoftware.com. In the section on “Periodic Table Games,” students are asked to “click on the element with the atomic mass of 58.693.” Selecting the incorrect element leads to the system feedback “Oops, that is incorrect. Please try again.” Selecting the correct answer, which happens to be nickel, yields the feedback “Correct!!!” accompanied by extensive information about that element. It is hard to imagine why a student would care to play such a game.

Other educational game developers seek to train simple skills in a drill-and-practice fashion in the belief that games are best used to motivate student interest in subject domains that students find boring or tedious to learn. They may try to achieve this by introducing game-like elements such as providing achievement scores and embedding competitive play against the computer as opponent.

The website chemistryteaching.com contains an example that focuses on atoms, symbols, and equations. Using an interface comprising both text and molecular representations, students are tasked to “balance the equation for the combustion of methane.” The left side of the window shows the “Reactants” methane and oxygen, while the right side shows the “Products” carbon dioxide and water. The student is instructed as follows: “Click on each of the molecules in turn, until you have a balanced equation, then click OK.” The correct answer, represented as a chemistry equation, is:



That is, one molecule of methane and two molecules of oxygen react to form one molecule of carbon dioxide and two molecules of water. Given that the end products are already given in the body of the question, the skill involved in balancing the chemistry equation becomes fairly trivial. The student merely varies the number of each type of molecule in the chemistry equation. The correct answer is easily obtained.

Focusing on content mastery, as the examples above illustrate, greatly simplifies the task of assessing student learning outcomes. Through design, the response space is cast in terms of a predetermined set of response possibilities that are discrete and non-overlapping. Consequently, answers provided by students are necessarily either right or wrong. The constrained response space imposes a stylistic over-simplification on the learning task and severely limits the potential for meaningful learning.

Underlying the pre-occupation with content mastery is a deeper ontological problem. Implicit in the focus on educational content is the assumption that learning revolves around the acquisition of “knowledge” and “skills.” This conception is consistent with the classical distinction drawn between declarative and procedural knowledge: knowing that and knowing how. An ontology of learning predicated on “knowledge” and “skills” severely constrains design possibilities for pedagogical innovation with games. It further limits the potential of game-based learning to make a critical difference in education, especially from the perspective of new media (Dovey and Kennedy, 2006, Lister et al., 2003) and new literacies (Coiro et al., 2008, Gee, 2004, Lankshear and Knobel, 2006). The learning experience is restricted to the realm of symbolic and pictorial representation at the expense of unique affordances provided by 3D game environments such as embodiment, immersion, and first-person action, that create a sense of presence *in* an environment and of “being there.” In the next section of the paper, I direct attention to these properties to make a case for game-based learning as performance. The subsequent section reifies the theoretical ideas introduced via a case example, based on the game “Legends of Alkhimia,” that is instantiated within the Performance–Play–Dialog model of game-based learning.

2. Learning as performance

Computer and video games constitute a unique digital medium that supports *first-person* immersive learning. However, traditional teaching and learning, especially as it is commonly practised in schools, emphasises third-person learning. Given the orientation toward fostering subject content mastery, teachers expend a great deal of time and effort *telling* students about domain content. Teachers engage in telling to achieve the first level of *knowledge* in Bloom’s taxonomy of thinking skills in the cognitive domain. They hope that students will also *comprehend* what they are told, and thereby advance their thinking ability to the second level in Bloom’s taxonomy. To the extent that anything needs to be *done* by students, teachers then assign students a task and instruct them to *apply* what they have learned, to advance student thinking to the third level in Bloom’s taxonomy. For real world tasks, which naturally tend to be somewhat complex, this instructional approach has a tendency to quickly lead to breakdown. To illustrate, consider a child learning to swim for the first time. Suppose that the swimming instructor delivers a series of outstanding lectures about swimming. He then tests the child’s “comprehension” of swimming using multiple-choice questions. Suppose further that the child attains a high score on the test. The instructor then instructs the child to “apply” what she has learned by swimming three lengths of the pool. Is the child likely to succeed?

The example above illustrates that knowing is distinct from knowing *about*. There is no easy way to translate information narrated in third-person terms to the capacity to act in first-person terms. Knowing in a linguistic, conceptual, and third-person sense, is a very different phenomenon from knowing in an embodied, enactive, and first-person sense (Gibbs, 2005, Johnson, 1987, Johnson, 2007). To assume that people learn to do by being told is a common fallacy. I am not suggesting that

being told is necessarily unhelpful to the process. Rather, I wish to suggest that learning to do, that is, performative mastery, can *only* be attained by direct engagement in doing. Classical epistemology commits the error of assuming a knower who exists independently of that which is known. However, as Dewey and Bentley (Dewey, 1949/1991) argue in their essay “Knowing and the Known”, there is no such possibility because every knower is always already situated in and part of the world (Bateson, 1979). Coming to know, therefore, requires a process of direct engagement with the phenomenon of interest in the world. It mandates that learners be engaged in the performance of meaningful tasks that allow the development of enactive capacities pertinent to valued social practices.

In the context of education, the philosophy of pragmatism stakes the claim that learning outcomes must make a practical difference to students’ lives by developing their capacity for *effective action*. For William James and John Dewey, commonly regarded as the founders of pragmatism, human needs, interests, and purposes are pre-eminent in thought and action. James insists: “My thinking is first and last and always for the sake of my doing” (James, 1890/2007, p. 333). For both James and Dewey, thinking is a process that emerges from and is continuously controlled by *non-cognitive* levels of experience that include emotion, habit, and imagination (Holder, 1995). Cognitivist models of thinking are rejected because such models over-strongly foreground “mental structures” at the expense of non-cognitive aspects of experience such as habits, values, and beliefs.

Reconstructing cognition from the perspective of pragmatism, thinking is understood as a process situated inextricably in experience. Dewey argues that experience has as its basic pattern a two-way *transaction* of an organism and its environment. He was dissatisfied that modern theories of experience fail to carry the sense of doing (*praxis*) and being done to (*pathos*) that the concept had borne from the time of the ancient Greeks, and that it had become exclusively identified with that which is intellectual and cognitive (Garrison, 1998). According to Dewey, experience involves embeddedness in a situational context that has structural complexity, and structural complexity invokes the qualitatively immediate features of experience such as emotions, feelings, and attitudes.

Based on the pragmatist idea of learning necessarily taking place in situated action (Coulter, 1989, Wertsch, 1998), I propose the construct of *performance* as a productive basis for understanding learning through the theoretical lens of *being* and *becoming* (Chee et al., 2009, Semetsky, 2006). The construct of performance is drawn from the domains of performance theory and performance studies (Bell, 2008, Carlson, 2004, Schechner, 2006). According to Bell (2008), performance has three key characteristics. First, it is *constitutive*; that is, it is established, created, and given form through enactment. Second, performance is *epistemic*: that is, performance is a way through which human actors come to know themselves, know others, and know the world. Third, performance is *critical*; that is, it provides a means for actors to stake claims about knowledge and the creation of knowledge. Performance holds possibilities to imitate a life world, to create a life world, to transform a life world, and to stake claims about that life world.

Performance is also deeply constitutive of *identity* (Benwell and Stokoe, 2006, Chee, 2007, Holland et al., 1998). Implicit and explicit claims about that which is valued by human actors, as well as how these actors as members of a group ought to act, are manifested through performance. Because game play involves *being* a person on a developmental trajectory of *becoming* within a fictional game world, it inherently entails players constructing a sense of who they are and the kind of person they want to become—that is, their identity—through the very act of game play. Assessing student learning outcomes based on performance, in the sense just articulated, provides a powerful and appropriate basis for evaluating learning gains: gains that are lasting and might be said to have become “part of” a person, rather than content mastery gains that are often soon forgotten. Performances are always based on and manifest values implicitly. Understanding learning as performance thus leads to a very different ontology of learning. Instead of a pre-occupation with knowledge and skills in the Bloomian sense of these terms, the vocabulary of learning shifts to one that emphasizes *values*, *identity*, and *performance*: the VIP ontology. In this ontology, performance subsumes knowledge and skills, as conventionally understood, and transcends them to manifest as an integrative, embodied, and enactive capacity to engage productively in situated action. In short, the performative goal is the attainment of a capacity for “knowing in action” rather than knowledge as an entity per se.

Aligned with Dewey’s pragmatic stance, performance entails living, experiencing, and acting in the here-and-now. Through performance, performers wrestle with human experience as a lived and always dynamic process, and they develop participatory and embodied ways of knowing and being.

Experience is made available for contemplation, thereby providing opportunities to *think* and to think *differently*; in short, to learn in an experientially grounded way.

3. Case example: Legends of Alkhimia

In this section of the paper, I reify the theoretical ideas articulated above based on the educational game “Legends of Alkhimia” (LoA). This game has been developed at our research centre. It will be used in two classrooms, in separate schools, in mid-2010. LoA is a multiplayer game that supports up to four concurrent users. The game is designed to support authentic learning of chemistry by 14-year-olds at the lower secondary school level. In the first subsection, I describe the pedagogical model of game-based learning that provides the foundation for our classroom research. In the second subsection, I illustrate game play and make connections to the conceptual ideas that frame my work.

3.1 The pedagogical model

The pedagogy underlying the design of LoA is that of learning as inquiry, in the spirit of Dewey. Dewey argues that the origin of thinking arises in a feeling of perplexity or doubt in the non-cognitive background of embodied experience. Inquiry begins in doubt and concludes when the stimulus of doubt is removed. In the activation of thinking, the qualitative immediacy of experience is transformed from the level of feeling to a level where possibilities and connections are recognized. Such possibilities and connections are exploited at the cognitive level for use as ideas and plans of action. Even as cognitive events transpire, substantial portions of the non-cognitive dimensions of experience are retained, and they serve to regulate the thinking experience. On Dewey’s account, the emergence of thinking represents the emergence of a new organization of experience (Holder, 1995). Educational aims must be translatable into teaching methods that fit the activities of those receiving instruction, and education administrators must foster the kind of environments required to liberate and to organize the thinking capacities of students. Figure 1 depicts the Performance–Play–Dialog model of game-based learning designed to achieve this.

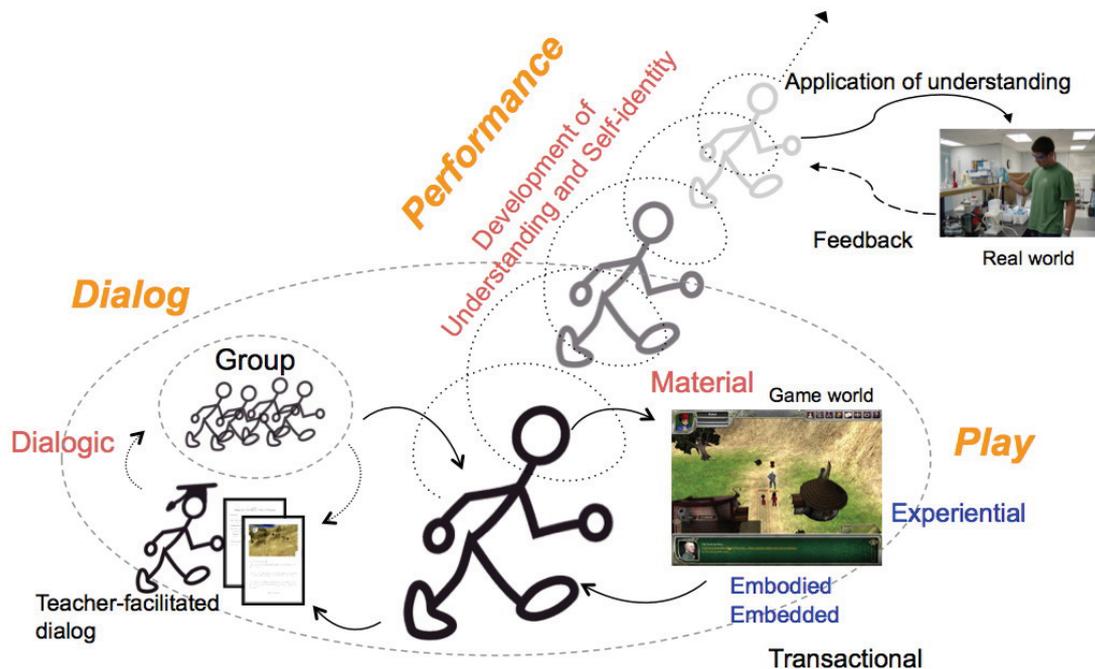


Figure 1: The performance–play–dialog model of game-based learning

As shown, the primary thrust of learning is driven by performance that encompasses the development of understanding in the subject domain and the construction of self-identity with respect to that domain. Through performance, students develop new ways of seeing and understanding the world and of understanding themselves in relation to that world. The construction of an expansive yet coherent worldview, coupled with the agency to act, is central to learning that is developmental and empowering. Figure 1 shows this future-oriented pathway of a learner as a trajectory of becoming through which the learner develops understanding in and practice of a professional domain.

Performance itself is realized through the sub-constructs of play and dialog, both of which are performative processes in their own right.

Students' learning is mediated by engagement in play via a material, digital game world. The space of play is experiential, and learning actions are transactional. The player's experience is embodied, by virtue of being represented in the game world by his avatar, and the player is embedded, or immersed, in the virtual space of the game world. In the design of our learning curriculum, students play multiple levels of the game LoA. Game levels build incrementally on one another to help students develop the dispositions and habits of mind related to professional practice in the domain of chemistry.

Dialogism, a key Bakhtinian (1981) idea, is central to our pedagogical design of the curriculum. For Bakhtin, dialog is not constituted merely by words or by talking. Dialog is also ontological: it is a way of life. In the context of the classroom, dialog is intended to help students achieve comprehension rather than to provide an explanation. Dialogism generates internally persuasive discourse that is *open*, allowing students to construct new ways to mean. Fostering dialog in the classroom creates a more open yet more critical disposition toward discourse and the knowledge construction process. As ideas collide and are interrogated, students learn that the practice of science is itself a process of sense making, and, hence, a dialogically constituted activity. Consistent with Deweyan pragmatism, they learn that scientific "facts" are warranted assertions and hence tentative in nature rather than eternally "proven" claims. Dialogism thus sustains inquiry as an open process and allows students to participate in the social construction of reality (Berger and Luckmann, 1966). Based on the model, play and dialog stand in dialectic relation to each other. Play sustains dialog, and dialog informs play.

3.2 The game Legends of Alkhimia

LoA is an eight-level four-player game. In the Level 1 opening scenario, the four players crash-land in the environs of the ancient town of Alkhimia. They have with them certain weapons, a form of gun, that shoot ammunition drawn from cartridges attached to the weapons. On getting out of their aircraft and surveying the surroundings, several monsters, emerging from a narrow mountain passageway, suddenly attack them. The players use their weapons against the monsters, but find their weapons to be ineffective. This situation sets the context for the players to inquire into what kinds of substances their ammunition is made of and to synthesize more effective ammunition that will be able to destroy the monsters. The players soon learn of the strange incidents that have been occurring in the once sleepy town of Alkhimia from the villagers that they meet: the legends of Alkhimia. The villagers seek the help of the players to solve the mystery of the marauding monsters. The players promise to help, with a view toward putting their understanding of chemistry to good use by helping the villagers to deal with their problem.

I shall draw on Level 3 of the game to illustrate LoA game play. In this level, the villagers send the players a desperate request for help because some slimy looking monsters have started to attack their cabbage patches. Some of their crops are burning because the fireballs that the monsters wantonly hurl around have struck their farmland. The players come to the rescue of the villagers. They battle against the monsters using substances that they have previously separated in the chemistry lab as well as other substances they find in the lab. After a furious battle, the players manage to kill one monster, while the other monsters take flight (see Figure 2). Unfortunately, as the dead monster's body decays in the open field, its decomposing body matter liquefies and begins to contaminate the villagers' cabbages. Some cabbage patches from a plot of normal-looking purple cabbages turn into bright red cabbages. The players are given the challenge of trying to establish what kind of substance the dead monster is made of so as to reverse the unsolicited transformation on the once-normal cabbage patches.

With a sample of monster residue in hand, the players teleport to the chemistry lab where they experiment individually with different substances to devise a solution for getting the cabbages to revert to their original colour. In the course of the lab work in Level 3, students experiment with and make sense of chemical reactions that entail the generation of acids, bases, and salts. Taking advantage of fictive imagination in game design, the cabbage leaves fulfil the role of litmus paper. The red cabbage leaves are an indication that the monster waste is acidic. Figure 3 illustrates the situation where a student has added an appropriate insoluble base into the conical flask containing the monster waste, resulting in the cabbage leaf reverting to the original colour purple. With the appropriate substance in hand, the player returns to the contaminated field and disperses the

insoluble base over the contaminated cabbages to make them return to normal cabbages, thereby making the villagers happy.



Figure 2: Players battling invading monsters in Level 3 of *Legends of Alkhimia*



Figure 3: A student testing different substances to reverse the effect of cabbage patch contamination by the dead monster's body

In the LoA curriculum, the fostering of student identity is of special significance. Prior to entering the game world, the players are positioned by the game as aspiring scientists (chemists) who learn their craft under the tutelage of their boss, Master Aurus. In the game lobby, they select their visual persona in the player customization screen to reflect their sense of personal identity at the commencement of the game. As game play proceeds, the game narrative as well as the game interface provide opportunities for the player to modify the avatar's look and feel so as to foreground the values they adhere to via their self-presentation. For example, in a later game level, players have to choose a piece of armour for themselves. The armour choices are designed so as to represent different kinds of symbols such as those representing notations related to chemistry or signs that depict an accomplished warrior. At the same time, the game itself promotes certain values. The game narrative casts students in the role of using their understanding of chemical reactions to help the villagers to suggest that science should be used for human good. This theme contrasts with students discovering toward the end of the game that it is their trusted master, Aurus, who has been behind the unseemly happenings in Alkhimia: all for personal power and gain. These in-game "discoveries" provide the impetus for dialoguing, in the classroom, about appropriate ways of using scientific knowledge.

As students continue playing LoA, the chemistry involved becomes increasingly complex. Like the apprentice scientists that the game positions them to be, they are *required* to develop their own classifications of the substances that they encounter in the game world. They do not experience the world as a pre-labelled and a pre-configured place. This pedagogical design inducts students into an authentic practice of science making by requiring them to *construct* functional and concise representations and organizations of knowledge as part of the process of inquiry. In so doing, students develop a practical sense with and of chemistry as a professional domain of practice. Drawing upon the knowledge constructions of different student groups, the teacher helps students to make critical evaluations about the constructions proposed by different groups. In this manner, students begin to understand that the construction of scientific knowledge is a social enterprise based on a set of values that esteem simple, parsimonious, and generalizable explanations. Students thus learn to imbibe the values, dispositions, and beliefs that undergird the practice of science *making*. At the same time, they appropriate the *habitus* of professional practice, including the values of critical reflexivity and epistemological vigilance (Bourdieu, 1977). We anticipate, by design, that learning chemistry in this manner will yield rather different outcomes compared to traditional emphases on content mastery. Students will come to *know chemistry performatively* rather than merely end up *knowing about* chemistry.

4. Conclusion

In this paper, I have argued that evaluating game-based learning outcomes on the sole basis of content mastery, as is widely practised, is misplaced on epistemological grounds: to know is not equivalent to knowing *about*. The pre-occupation with educational content and the assessment of its acquisition also severely limits the conception of game designs to those that target content and skills. A learning ontology couched in terms of values, identity, and performance raises the bar for the design of pedagogically sound games, without sacrificing traditional concerns over knowledge and skills. Understanding learning as performance levels up the standard to which the design of educational games should aspire. Game-based learning that targets students' embodied and performative capacities in relation to authentic learning and professional practice entail deeper and longer lasting learning gains. Such gains sit comfortably within the educational tradition of pragmatism that upholds the vital importance of learning that impacts directly and positively on students' lives in terms of what they are able to do in the world—their performance—and the kind of self that they wish to become—their identity. The case example of learning chemistry with the game "Legends of Alkhimia" served to reify the theoretical constructs and to illustrate the translation of the conceptual ideas into the concrete design of an immersive, first-person educational game. The use of the game by students is guided by the Performance–Play–Dialog model of game-based learning that emphasizes the criticality of designing for learning within a socio-cultural context because dialog and meaning making, including scientific meaning making, are fundamentally and inextricably social in nature.

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