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**STRUCTURING NARRATIVE IN 3D DIGITAL GAME-BASED LEARNING  
ENVIRONMENTS TO SUPPORT SECOND LANGUAGE ACQUISITION**

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### **Abstract**

The essay is a conceptual analysis from an instructional design perspective exploring the feasibility of using three dimensional digital game-based learning (3D-DGBL) environments to assist in second language acquisition (SLA). It examines the shared characteristics of narrative within theories of situated cognition, context-based approaches to SLA, and game studies as a means of developing meaningful, engaging, and instructional gameplay in 3D-DGBL environments. At the conclusion of the essay, a design rubric is proposed for aligning gameplay in 3D-DGBL environments with concise performance objectives in order to support assessable learning outcomes. A theoretical approach for designing 3D-DGBL environments, the essay invites further discussion on the topic and calls for increased research and development in the area.

### **Keywords**

Digital game-based learning (DGBL); computer assisted language learning (CALL); learning environments; serious games; video games.

### **Biographical details**

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The recent MLA Ad Hoc Committee on Foreign Languages Report identifies a burgeoning national "language deficit" (2007, p. 2) and characterizes the two-tiered configuration that today artificially separates language learning specialists from literature faculty in university foreign language departments as being antiquated and inefficient. The unfortunate upshot of this artificial division is the prevailing curricular model that devalues the early years of language learning while simultaneously monopolizing upper-division language courses in the service of literary studies. Traditionally low enrollments in many foreign languages reveal this division to be particularly unappealing to many university students. Seeking broader and more diverse paths to mastery of a foreign language, students find the current two-tiered configuration to be both stifling and largely irrelevant to major tracks emphasizing the sciences and business.

As a corrective of the current two-tiered configuration, the MLA Report calls for the adoption of foreign language curricula that can increase the translingual and transcultural competence of a broader range of university students, not just those interested in literary studies. Ideal curricula will be those that "situate language study in cultural, historical, geographic, and cross-cultural frames; that systematically incorporate transcultural content and translingual reflection at every level; and that organize the major around explicit, principled educational goals and expected outcomes" (p. 5). In an effort to ensure that the study of foreign languages will remain relevant for a networked and digital society in the future, the MLA Report additionally calls for foreign language graduate studies to "provide substantive training in language teaching and in the use of new technologies in addition to cultivating extensive disciplinary knowledge and strong analytic and writing skills" (p. 7). To wit, the report invites increased efforts to delve into technical and disciplinary fields that traditionally have not been included in the study of foreign languages yet harbor the potential of transforming language departments into more "meaningful players in higher education" (p. 3).

Seeking to address the technical, interdisciplinary, and instructional needs outlined for language departments in the MLA Report, this essay, which is structured as a conceptual analysis from an instructional design perspective, will examine the feasibility of using three dimensional digital game-based learning (3D-DGBL) environments to assist in second language acquisition (SLA). Particular attention will be paid here to first-person 3D gaming interfaces of the single-player computer role playing game (CRPG) genre. Although some parallels can be drawn between this computer game genre and 3D computer-mediated communication (CMC) environments such as *Second Life* or *Quest Atlantis* (see Zheng, Young, Wagner, & Brewer, 2009), the types of player experiences fostered by 3D-CRPG are fundamentally different from those fostered by 3D-CMC as the latter supports virtual spaces in which "cultures and meaning emerge from a complex set of interactions among the participants, rather than as a part of a predefined story or narrative arc" (Thomas & Brown, 2009, p. 37). Specifically, the essay will:

- (a) examine the shared characteristics of narrative as defined by theories of situated cognition, context-based approaches to SLA, and game studies as a means of developing meaningful, engaging, and instructional gameplay in 3D-DGBL environments; and
- (b) suggest a design rubric for aligning gameplay in 3D-DGBL environments with concise performance objectives in order to support assessable learning outcomes.

The term "narrative" will be employed broadly in the essay to describe the dialogue that emerges between a learner and more capable peer, the sociocultural settings that contextualize language production and nuance its various manifestations, and the stories created by player interaction with a game system. Although the term will be applied broadly, the discussion will hinge on three fundamental characteristics of narrative, which are based in part on Bruner (1986, 1990, 1991) and which will serve as a type of lowest common denominator underpinning these varying theories and approaches. These characteristics are:

- (a) narrative: specific instances or events in time that form the basis of a story. According to Bruner (1990), narrative is "a unique sequence of events, mental states, [and] happenings" (p. 43) that can be expressed either in "words, cinema, abstract animation, [or] theater" and forms the "basic story stuff, the events to be related in the narrative" (Bruner, 1986, p. 19). Narrative, then, is medium-independent. Polkinghorne (1995) defines narrative as "the type of discourse composition that draws together diverse events, happenings, and actions of human lives into thematically unified goal-directed processes" (p. 5) and Miller (1995, p. 75) asserts that narrative at its most basic level must consist of a situation, the use of a sign system to create personification, and a repeated pattern of key elements. In sum, narrative is the basic "form of not only representing but of constituting reality" (Bruner, 1991, p. 5). For the purpose of our discussion here, narrative will include images generated by a 3D computer game and rendered on a console screen.

(b) plot: the ordering of events within a narrative text in order to form a story and the manner in which these events are apprehended on a personal level. Polkinghorne (1995) describes plot as "a conceptual theme by which a contextual meaning of individual events can be displayed" and as "the narrative structure through which people understand and describe the relationship among the events and choices of their lives" (p. 7). Akin to the *sjuzet* described by Bruner (1986), which is "the story as told by linking the events together" and "how and in what order the reader becomes aware of what happened" (p. 19), the plot represents a point of connection between narrated events, the actions of the protagonists, and their sense of subjectivity. For the purpose of our discussion here, plot will be informed by Nitsche's (2008) definition of the term, which groups plot with the "active interpretation of the fictional world" (p. 51) emerging from interaction with a 3D computer game and which encompasses the internal mental states, goals, motivations, and intentions of its players.

(c) story: the medium-specific representation of narrative events arranged according to personal interpretation in order to render a "verisimilitude" (Bruner 1986, p. 11) of reality. According to Bruner (1986), a story constructs two landscapes simultaneously. The first is the "landscape of action, where the constituents are the arguments of action: agent, intention or goal, situation, instrument, something corresponding to a 'story grammar'" and the second is a "landscape of consciousness: what those involved in the action know, think, or feel, or do not know, think, or feel" (p. 14). For the purpose of our discussion here, story, which the essay will also describe as a "narrative trace," expresses the individual player experiences within a 3D game world.

By drawing the definition of narrative as broadly as possible, while simultaneously focusing on its three fundamental characteristics, the essay hopes to make points of connection between theories of situated cognition, current SLA approaches, and the type of gameplay supported by 3D-DGBL environments, thereby offering suggestions for how 3D-DGBL can be implemented as a learning platform in foreign language curricula emphasizing situational knowledge, context-specific linguistic skills, and transcultural awareness. Seen within a broader framework, the essay will seek to develop for 3D-DGBL in SLA contexts what Blake (2008) identifies as "critical and rhetorical literacy" (p. 135), what Gee (2007) calls an "internal design grammar" (pp. 28-31), and what Zheng et al. (2009) describe as an "intentionality of instruction" (p. 505). Finally, the paper will serve as part of a preliminary first step, or analysis phase, in a standard ADDIE design approach (Dick, Carey, & Carey, 2001) for developing 3D-DGBL environments for SLA and will propose a tentative design rubric for their thoughtful and goal-oriented creation. Later papers will report on findings from subsequent steps in the development process and, it is hoped, other authors and researchers will also join in the discussion.

As a conceptual analysis the essay will not, however, seek to legitimate DGBL as a learning platform or provide immediate implications for the second language classroom. For guidance in this areas, it is suggested that the reader consult Gee (2007), who offers a seminal and easily-read study on the topic, and Neville (2009), who describes the benefits of DGBL for SLA in layperson's terms and provides an overview of currently available DGBL environments. For information on the effects that DGBL has on SLA and suggested best practices for its curricular adoption, the reader is referred to Neville, Shelton, and McInnis (2009), who report on a mixed-methods study evaluating the use of an interactive fiction game to teach introductory German to beginning university students. The reader is also advised to visit *The DigiBahn Project* research blog (<http://digibahn.blogspot.com>) for Web-based DGBL resources and descriptions of a 3D-DGBL environment currently in development for SLA (see also Figure 1 and 2). The author acknowledges that readers of the essay may not have the necessary technical skills (e.g., 3D game programming, digital art) to develop a 3D-DGBL environment on their own. However, by describing what is currently feasible, and by showing how gameplay aligns with accepted theoretical approaches to second language acquisition, he encourages interdisciplinary collaboration between people who *do* possess these skills and offers a possible road map for how this collaboration can move forward.

### **Comparing narrative: Theories of situated cognition, SLA, and game studies**

The essential insights that theories of situated cognition afford our current discussion are that knowledge is contextualized within physical and sociocultural spaces, that it is inextricably bound to the intentional action of actors within these spaces, and that these actors shape and transmit knowledge by means of narrative structures (Bruner, 1986, 1990, 1991; Lave & Wenger, 1991; Wenger, 1998). For our purposes here, this triad of knowledge, setting, and actors will be understood as a "problem space," or a unique constellation of "alternatives that a problem solver has available and the various states that can be produced during problem

solving by the decisions that the problem solver makes in choosing among alternatives" (Pirolli & Greeno, 1988, p. 182).

Seeing knowledge as being contextually situated has a profound impact on both teaching and learning. In particular, it fundamentally alters how a student interacts with a problem space and similarly influences the form that knowledge can assume within this space. For example: although pilot training consists of theoretical courses on the ground, it is also complemented by a substantial practical component both in the air and in flight simulators (see Hutchins & Klausen, 1996). Learning about how the flight deck functions in real-life is dramatically different than classroom-based discussions of the same topic and involves a complex process of hypothesis formation based on an understanding of theoretical knowledge, testing this hypothesis within a real or simulated problem space, receiving feedback, and then modifying and retesting the hypothesis. Performance feedback is provided not only by the instrument displays, or the condition of the immediate physical environment, but also by more experienced members of a flight crew whose job is to train the pilot and evaluate her competency. Learning, therefore, involves a complex process of situated "knowledge negotiation" between physical artifacts, more advanced practitioners, and a learner as the latter becomes enculturated within a particular community of practice and develops increasing competence with its practice-specific narratives (Lave & Wenger, 1991; Wenger, 1998). Vygotsky (1978) suggests that this process of negotiation is mediated by a zone of proximal development (ZPD) between the teacher and learner, or "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (p. 86; cf. Del Rio & Álvarez, 2007). As the learner becomes more adept in navigating a problem space and more integrated into its communities of practice, this guidance is gradually withdrawn, or faded, until support is no longer needed and the learner is naturally operating at the level of a more competent peer (see Daniels, 2007, pp. 317-322).

Narrative has an important role to play in the negotiation of a problem space and the process of enculturation. Bruner (1991) notes that people apprehend reality and organize knowledge by means of narrative structures and, furthermore, that these structures are the primary mode of communication underlying all human interaction. This narrative mode stands in contrast to the "logico-scientific" mode of structuring and transmitting knowledge, which, according to Bruner (1986), "attempts to fulfill the ideal of a formal, mathematical system of description and explanation. It employs categorization or conceptualization and the operations by which categories are established, instantiated, idealized, and related one to the other to form a system" (p. 12). Although logico-scientific mode is useful in describing the natural world in terms of causes and effects, it falls short in "constructing and representing the rich and messy domain of human interaction" (Bruner, 1991, p. 4) by myopically focusing on the general and the paradigmatic at cost of the unique, the fleeting, and the personal. Narrative, on the other hand, is uniquely positioned to account for these characteristics of human interaction as they focus on, among other things, unique patterns of events over time, the relation of these events to larger events, and the intentional states of the actors who move these events forward.

Whereas the logico-scientific mode concerns itself with truth statements and general paradigms, the narrative mode revels in the slippage between personal and communal interpretations of events, between local knowledge and larger communities of practice. As a student moves through the education process, she will encounter narratives that inform her immediate environment and will interact with them according to her personal trajectory of participation (Wenger, 1998). As Greeno (1998) notes, "regularities of an individual's activities, in a trajectory that spans participation at different times in a community and participation in different communities, are characterized as the individual's *identity*, which is coconstituted by the individual's relation to the communities and by the relation of those communities to the individual" (p. 6). The student's sense of individual identity, then, provides her with a subjective entry point into the narratives that contextualize her actions and thoughts, crafting a "plot," so to speak, that helps her to organize the problem space in her mind, interpret the behavior of the actors within this space, and make sense of the physical environment in which they are all located. She will develop mental scripts for dealing with different contingencies that may arise in this environment. Such scripts, which are essentially subjective "stories" of the narratives that constitute a perceived reality, are not monolithic and unchangeable structures, but instead must be continually validated, augmented, and corrected by the communities of practice that cohabit a problem space. They must, as Bruner (1991) describes, be "constituted in the light of the overall narrative" (p. 8) through a process of hermeneutic composability that shapes, directs, and explains these stories within larger epistemological contexts. Seen within the context of our discussion of teaching and learning, this interaction of personal stories and communal narratives implies that knowledge is not only created through internal cognitive processes but must also be substantially supported and validated by external sociocultural contexts, communities of practice, and negotiated meanings. Knowledge, then, is a fluid commodity that is actively constructed at the intersection of competing narratives, personal and communal, and is the result of thinking *and* acting.

Current sociocultural approaches to SLA similarly focus on this intersection of the personal and the

communal, with particular attention being paid to the linguistic artifacts that emerge there. Underlying these approaches is the assumption that language acquisition is not only an *intra*-mental process, or one that occurs solely in the head of the language learner, but is also *inter*-mental in the sense that it is situated within communities that share and shape a common linguistic system. Language acquisition is, as Lantolf (2000) summarizes, essentially a dialectic process of internalizing the linguistic system of a specific community of practice, which in turn then effects the manner in which the language learner both thinks and acts: "We come to organize and regulate our own mental and physical activity through the appropriation of the regulatory means employed by others" (p. 14). Influencing the manner in which a person both thinks and acts, language acquisition can be seen as a form of identity construction, shaping not only the internal thought processes of an individual but also influencing how the person functions in sociocultural spheres. This insight is of tremendous import for students of a second language and culture as, according to Ros i Solé (2007), they achieve proficiency "by exercising agency and projecting and resituating themselves themselves in the new community of practice by engaging and dialogically building their L2 identities with their audience and sociocultural context. They take positions of power and exercise their agency in the relations established in the second language" (p. 205). The examination of personal narratives as a mediational artifact has therefore been especially useful in analyzing how this process of internalization unfolds, as these narratives reveal, in an intimate fashion, the manner in which language learners reconstruct their social selves within the context of new linguistic and cultural communities. As Ros i Solé (2007) concludes, narrative analysis "permits us to approach identity in a context specific fashion, as narratives are a form of discourse conveying events that take place in a particular place and time and can be traced to a particular life" (p. 208).

Seen as a site of sociocultural mediation between the personal and the communal, the native and the foreign, narrative functions as a "third place" in and through which an individual can refashion her identity and reexamine the roles she plays within a new community of practice (*cf.* Kramsch, 1993, pp. 233-259). Block (2007) characterizes this refashioning process as a negotiation of difference between the individual and her environment, her past and her present, noting that the "fissures, gaps, and contradictions" it produces frequently gives rise to an ambivalent sensation of "feeling a part and feeling apart" (p. 864). The tension inherent in this ambivalence provides fertile ground for sociocultural approaches to SLA, and examinations of personal narrative have played a key role in uncovering the ways in which individual identity is restructured as a learner becomes more adept in a second language and culture. Pavlenko and Lantolf (2000), in their analysis of autobiographies of bilingual writers, discovered that personal narrative represents "a space where identities are reconstructed and life stories retold in the security of the double displacement granted by writing in a second language" (p. 162). Like spoken language, which people use as an organizational tool for structuring reality, narrative brings "past events (i.e. occurrences involving other people) into the present and for projecting the present into the future. In so doing, people are able to make sense, that is, make meaning, of what they do and of what others do with them" (pp. 171-172).

Narrative, then, serves as a vehicle for situating the self within a new community of practice, although it can also function in reverse as a means of making this community meaningful on a personal level. In her examination of an intermediate-level ESL writing exercise, Kramsch (2000) found that students would use narrative to reencode the story on which the writing exercise was based so that it could be understood within a framework of their own life experiences. The resulting narrative, situated at the intersection of intramental and intermental language acquisition processes, revealed "the dialogic construction of rhetorical roles through the written and spoken medium that students experience themselves as both private, individual, and public, social sign makers" (p. 151). Finally, shifting their focus from written texts to oral life histories, Coffey and Street (2008) found that personal accounts related in spoken fashion manifest clear structural differences and employ dissimilar narrative strategies from those related through a written medium. The authors conclude that learning a second language and culture is a layered process that constructs personal identities through time by making use of a range of cultural narratives as resources to create "figured worlds" (p. 454). At the moment of telling, however, these figured worlds "are shaped by the interpersonal dimension of narrative performance and are developed further through learners' cross-cultural, ethnographic-like experience" (p. 462).

The narrative mode is important for SLA, therefore, as it reveals not only that narratives are situated within specific social, cultural, and linguistic contexts and transmit the core values of the communities of practice that inhabit these contexts, but also that these narratives are ultimately negotiated on a personal level based on the identities, needs, and unique subjectivities of people seeking entrance to these communities. Each person provides a "plot," as it were, whereby these dominant narratives can be interpreted and internalized, creating a life "story" that can be evaluated as an independent artifact of this interaction. Many computer games manifest a similar core dynamic. Providing simultaneous audio and visual input, and moved forward primarily by player interaction, which in turn is guided by a backstory that situates the player within the game world, the narrative generated by computer games is highly immersive and necessarily participatory in nature. The immensely popular *Half-Life 2* (Valve Entertainment, 2004) has, for example, a rich narrative that is developed

by a wide range of non-player character (NPC) dialogue, in-game physics, dramatic staging, scripted transitional sequences, level design, interactive 3D models, and sound effects (see Figure 3). A substantial part of the narrative in *Half-Life 2* is visual and spatial in nature, representing a type of "invisible storytelling" that used "shapes and symbols to tell a story similar to the way letters and words are used to compose a written narrative" (Van Zelfden and Alexander, 2007). This narrative, in turn, produces a type of virtual record that gives "every location in the game a sense of place, history and verisimilitude" (Parkin, 2009). The virtual spaces of *Half-Life 2*, and those rendered by many 3D-CRPG interfaces, for that matter, can therefore be experienced as a narrative text that the player structures at the very moment in which an action is performed within the game. Unlike traditional forms of linear narrative (e.g., books and film), gameplay must first be "configured" in order to be interpreted (Moulthrop, 2004), giving rise to a "ludic pleasure" that is rooted in the "kinaesthetic, functional, and cognitive" challenges of managing a virtual topography (Aarseth, 2004, Art of Simulation section, para. 2). The figured worlds that unfold through this interaction, each one being slightly different based on player input, performance, and personal preference, are a direct result of the player feeling her way through the contours of the game world on a physical, mental, and emotional level and, as a result, form a unique story that is as singular as the players who interact with the game. They are, in sum, the product of a personal reaction to a simulated community of virtual practices.

Yet how these worlds unfold is a topic of intense debate within the field of game studies, although the tenor of the debate has softened somewhat as of late. At the heart of the debate is whether to consider a game primarily in terms of its rules, which support specific processes of gameplay (*ludology*), or in terms of the narrative structures it employs, which are revealed to the player during gameplay (*narratology*). Although admitting that games and narrative share similar structural traits, and that narrative can be applied *a posteriori* to gameplay as an interpretive framework, Juul (2001) goes on to argue that the experiential narrative of games is fundamentally different from other forms of narrative in that game interactivity demands player action and input in the present moment in order to move the narrative forward: "[. . .] the game constructs the story time as *synchronous* with narrative time and reading/viewing time: the story time is *now*. Now, not just in the sense that the viewer witnesses events now, but in the sense that the events are *happening* now, and that what comes next is not yet determined" (Time in the Computer Game section, para. 2). In a similar vein, Kücklich (2003) notes that "narrative is not an inherent feature of games, but something merely implemented virtually, i.e. as a possibility. The actual construction of narrative is always done by the player by taking the signs on the interface and interpreting them further" (Narrative section, para. 2). The act of generating narrative in a computer game, then, is a form of interactive semiosis, requiring the player to make sense of in-game signs and their relationship to each other the moment in which they are presented. However, whereas Juul seems to suggest that there is very little distance between narrative and story, or between in-game events and the personal interpretation of these events, Kücklich argues that the interactive semiosis fostered by gameplay unfolds through a process that necessarily creates a third space in which this interpretation must occur. Conceptualizing a computer game as a system of signs that resist the player by virtue of their secondness, Kücklich suggests that the process of interpretation causes the player to bring these signs into relationship with each other: "This whole process takes place on a level that cannot be located within the game, but exists merely as a projection of the player's mind. In this model, narrative is something that unfolds because of the player's attempts to make sense of the game. The basic resistance, or secondness, is necessarily unstable, since the player cannot help but interpret this state, thus causing the semiosis to change to a state of thirdness" (Narrative section, para. 5).

Lindley (2002) similarly notes that the ludic aspects of gameplay, which occur at a lower level of game interaction, generally have very little to do with the narrative development of a game at a higher level, causing a split between individual actions that occur within a game and the framing of these actions within the narrative of an overarching story. He suggests, however, that this split may simply be a question of how a player approaches the game, specifically what mental gestalt, or pattern of interaction, provides the cognitive background underpinning all player performance within the game, and for which mental gestalt the game is originally designed. A gameplay gestalt, such as can be found in the "twitch" gameplay of first-person shooters (e.g., iterative patterns of "run - aim - shoot"), supports non-semiotic patterns of performance that separate the player from the narrative by creating "a form of dissolution of consciousness into the moment, acting against the strong incorporation of moments into an unfolding story structure. . . [it] is an operational pattern rather than a mechanism for learning declarative facts" (p. 213). This type of gameplay stands in stark contrast to gameplay designed to support a narrative gestalt, which is "a cognitive structure allowing the perception and understanding of an unfolding sequence of phenomenon as a unified narrative" (p. 209) and requiring the negotiation of "a varied emotional and thematic space of character interactions, where progress becomes a matter of developing emotional and thematic understanding" (p. 214). The irony, then, is that the very action supported by computer games as an interactive, experiential medium, which allows narrative to unfold, may, in the end, also prevent narrative from being understood as a unified, cohesive whole unless in-game action can be skillfully and properly managed. This observation is important for our discussion of 3D-DGBL for SLA as it

highlights a potential obstacle to opening a space within a game that, similar to the third space that emerges during the second language writing process, allows the player to separate individual performance from in-game narratives, or the real sociocultural narratives they represent, and to reflect on questions related to identity formation within specific communities of practice. Although the mastery of basic operational patterns is undoubtedly useful to have when navigating a second language and culture, optimized gameplay, at least for SLA purposes, should seek to merge gameplay with larger narrative questions such as player identity formation, with the result that "[p]lay oriented toward characterization requires the moves of the game to be geared toward answering the question 'who am I' as a character within the game world" (Lindley, 2005, Narrative section, para. 8).

Finally, focusing primarily on how narrative structures in computer games can be leveraged to create meaningful play, Salen and Zimmerman (2004) do not draw a sharp distinction between narratology and ludology, instead arguing that the underlying question is not "*if* games are narrative but *how* they are narrative" (p. 379). The authors describe two forms of narrative that can be found in the dynamic structures of digital game systems: embedded narrative, which is pre-rendered narrative content that exists in a final form before a player's interaction with the game and which provides the kind of narrative experiences that linear media forms such as cinema provide, and emergent narrative, which occurs in unexpected and uniquely different ways when the player interacts with the underlying rules of a game system. Meaningful gameplay and narrative experiences, they conclude, are achieved by addressing the goals, conflict, uncertainty, and core mechanics inherent to a game system (pp. 385-390). Yet all these these building blocks, the authors assert, can be subsumed under the rubric of the game as a virtual narrative space, in which "[e]very element. . . brims with narrative potential. The narrative components of a game are not just the backstory and cutscenes. *Any* representational element can be a narrative descriptor, an opportunity for you to communicate the story you want your players to experience. . . Nothing is irrelevant: every piece helps tell the story, which is greater than the sum of its parts" (p. 401). Seeing a game system as composed entirely of narrative descriptors, which "imply a representational logic that limits and constrains the design of a space of possibility" and which allow "for the integration and discernability of all elements contained with game world, a world whose setting describes the limits of its own action" (p. 403), permits us to make points of connection between the narrative structures found in a 3D-DGBL experience, the real sociocultural narratives that the game system attempts to simulate, and the goals of a SLA classroom. Just as a foreign culture and language will allow or disallow certain actions in real life, so too will a game system empower or limit player performance based on the narrative structures made available within the system itself. The key concern, so it seems, is how best to ensure that the narrative structures simulated in a 3D-DGBL environment closely resemble those in the real world so that meaningful play – and therefore meaningful learning – can occur.

By comparing descriptions of narrative as articulated in theories of situated cognition, current SLA approaches, and ongoing debates within the field of game studies, a more nuanced and informed understanding of the role that 3D-DGBL can play within SLA emerges. As we have seen above, theories of situated cognition stress the highly contextualized nature of knowledge and learning, with both being dependent on the communities of practice that occupy a given sociocultural space, the actions of actors within these communities, and the manner in which new actors are brought into a community. Knowledge is not only "in the heads" but also "between the heads" of these actors, and the environment that surrounds them determines which actions are performable and the manner in which they are ultimately performed. Furthermore, as narrative structures give a voice to the intentional states of the actors who perform these actions, they allow for a very personal means whereby knowledge is transmitted and evaluated. In a sense, then, narrative represents a point of connection between the personal and the communal, between micro- and macro-narratives. SLA research into narrative structures focuses almost specifically on this point, noting that the process of adopting a new linguistic system, or community of practice, is a complex process of identity formation that is negotiated between the individual, her past, the perceived future, the linguistic system, and people who make use of this system.

A 3D-DGBL experience adapted for SLA purposes would be unique in that it would allow a language learner, albeit virtually, to "play" a community of practice, become familiar with its narratives, associate these narratives with 3D representations of real sociocultural spaces, and begin the complex process of identity formation before actual immersion abroad. As Zheng et al. (2009) observe, virtual worlds enable "physical and avatar movements as well as associated speech acts that invite language learning through cycles of perception and action in the embodied lived-in (or virtual) world" (p. 491). Thomas and Brown (2009) note that this cycle of perception and action allows players

to develop a sense of identity and belonging in the world. Knowledge within this context is not simply about what one knows or even how one knows, but is a level of being situated where one learns what the right things to know are. They do so by negotiating their in-game sense of agency with the game-based institutions that are provided for them by the developers. The situation is determinative insofar

as one's identity is defined and constrained by the "rules of the game" or the structures of the world. As such, situated learning can provide some insight into how games can be used as powerful teaching tools providing a strong institutional grounding to define a player's sense of agency and identity. This is true, to varying degrees, for most games that are created. (p. 40)

Furthermore, the current discussion in game studies simply corroborates what proponents of theories of situated cognition have long suspected: That the semiotic encoding of an experience – of turning action into narrative – is central to the learning and knowledge transfer processes. After all, narrative structures are the means whereby we organize our experiences, classify them, relate them to others, and store them for future reference. Encouraging the formation of mental narratives, therefore, is an integral and essential step toward meaningful and permanent learning. However, computer games also show us that this can be difficult to do, as the medium itself can coopt the message and actually work counter to the production of narrative. Clearly, articulating best practices for encouraging narrative development in immersive 3D learning environments, including 3D-DGBL, will be one of the central and pressing issues as SLA moves forward in the 21st century. The remainder of this article will be a step in this direction, suggesting guidelines for developing and testing 3D-DGBL environments for SLA contexts.

### **Structuring narrative in 3D-DGBL environments**

Based on the type of narrative they present and the forms of player experiences they generate, computer games seem a logical fit for simulating the ill-structured learning environments that students will encounter while learning a second language and culture. These environments, according to Jonassen (1997), are characterized by emergent dilemmas that one encounters in everyday practice and "because they are not constrained by the content domains being studied in classrooms, their solutions are not predictable or convergent. They may also require the integration of several content domains" (p. 68). On account of their emergent nature, however, the ill-structured learning environments found in computer games can prove difficult for new learners to manage (*cf.* Neville, Shelton, & McInnis, 2009). In her conceptual analysis of the design of computer adventure games, Dickey (2006) suggests that the narrative inherent to this genre of games may provide a motivational and cognitive framework that could assist learners with navigating their complex, multimodal, and ill-structured problem spaces. Key to leveraging narrative within interactive and game-based learning environments is deciding "to what degree game design narrative might be integrated and determine where and how the learner would be situated within the narrative" (p. 257). To assist in this process, the author outlines a design heuristics for integrating game narrative into instruction and addresses issues of, among other things, framing the initial challenge and minor challenges, identifying potential obstacles and puzzles, establishing the emotional and ethical environment, and creating a backstory (pp. 258-260). Such a framework seems highly desirable for developing 3D-DGBL environments to teach a second language and culture as these tasks also require the learner to integrate and evaluate knowledge from numerous diverse content domains.

A problem presents itself, however, with regard to player agency and interpretive freedom. Our prior discussion of narrative structures in SLA contexts revealed that narratives are rarely – if ever – accepted at "face value," so to speak, but rather undergo a complex and interactive process of interpretation on their way to becoming personal stories. This process not only reshapes the identity of the second language learner but, in turn, also reshapes the narratives themselves. Within a computer game, a similar process of narrative interpretation occurs at the moment of player interaction with the game interface, a process which elsewhere has been described as a future-oriented cybernetic feedback loop (Atkins, 2006). To summarize roughly, gameplay determines which narrative will be revealed in the game, which in turn influences the internal intentional states of the player, which finally impacts how the the player sees herself within the game world and how the game is subsequently played. This subsequent gameplay has a direct influence on all future game states, the manner in which narrative is revealed to the player within these states, and the reactions of the player to this revealed narrative (see Figure 4). Player interaction with a computer game, therefore, causes narrative to be revealed in a non-linear and unpredictable fashion, which can be explained only in light of prior game events, the internal thought processes of the player at the moment an action is performed, and cumulative character development within the game. As each player's interaction with the game is as unique as the players themselves, the sum of these game states forms a narrative thread that traces or "plots" a trajectory of player thought *and* action within the game world, ultimately forming a "story" that transmits a personal and subjective account of her experiences within this world.

An interesting dynamic emerges, then, between the emergent narrative that a player generates through interaction with the game and the embedded narrative that a game designer creates in order to structure this interaction. On the one hand, players can freely move around a game space, pick objects up, and randomly speak to NPCs in order to obtain information for advancing the game or developing the game world in greater

detail. Granting the player a large degree of personal agency and individual choice, this type of emergent gameplay empowers the player to create her own narrative traces, or stories, that detail her subjective experience and identity formation within the game world. On the other hand, if a game were to consist entirely of emergent narrative, it would be extremely difficult to advance its story arc, designing effective and measurable learning situations would be more difficult, and gameplay would begin to more closely resemble that found in 3D-CMC environments (*cf.* Thomas & Brown, 2009; Zheng et al., 2009). To maintain a sense of momentum in the narrative, game designers frequently employ cutscenes, including non-interactive scripted sequences, to advance the story arc and direct players along predetermined paths of activity supported by the game environment. As cutscenes are frequently revealed to the player upon completion of a key game level or challenge, they commonly bridge game levels and serve as a point through which all players must pass in order to advance in a game. Embedded narrative, therefore, frequently functions as a "loop" through which the various traces of player interactivity are threaded, lending an overall structure to the game experience while simultaneously allowing players to create and explore an autonomous identity within the game world. Nevertheless, as Piirainen-Marsh and Taino (2009) have demonstrated, even though embedded narrative requires less player interactivity, they can serve as valuable resources for repeating and imitating meaningful chunks of language, which "enables the players to adopt them into their own repertoire so that the patterns may become available for recycling in other contexts" (p. 165).

For example, Figures 5 and 6 graphically illustrate how embedded and emergent narrative function together to create unique narrative traces, or stories, within a hypothetical game level in which two different players resolve the primary level challenge in different ways. Tasked with purchasing a subway ticket in a foreign city, Player 1 first speaks with NPC 1 in search of clues and is referred to NPC 2 for additional help (see Figure 5). Player 1, however, has had negative experiences with a different NPC similar to NPC 1 in the past and would like to avoid all contact with these types of NPCs. Picking up on a clue dropped in the dialogue presented by NPC 1, Player 1 instead proceeds to find Game Object 1, a traveler's guide located at a newspaper stand explaining that all subway tickets can be bought from a vending machine located at the entrance to the subway station, which Player 1 then promptly locates. Player 2, however, takes a different approach (see Figure 6). Not having had the same negative experiences as Player 1, she immediately goes to NPC 2 after speaking with NPC 1, from whom she finds out that subway tickets can be purchased from the vending machine located at the entrance. Discovering that Player 2 is a foreigner in the city, however, NPC 2 gives her extra advice on how to buy the ticket. Both Player 1 and 2, having reached the vending machine, are shown a cutscene depicting how this particular type of vending machine works and how to purchase a subway ticket in a foreign city before advancing on to the next game level. Although both players have demonstrated their ability to navigate the same problem space and have received similar training on how to operate a vending machine, they have developed very individual patterns of problem solving based on personal preference, individual thought and action, unique language usage, their own "goals and intentions" (Zheng, et al., 2009, p. 505), and prior experiences in the game world. In sum, they would have developed complex and nuanced sets of multimodal social and communicative practices that not only can be used for navigating a particular community within the game (Steinkuehler, 2007), but also could be applied to the real-world communities that the game emulates.

Seen from an instructional perspective, this example demonstrates that gameplay in 3D-DGBL environments would oscillate between brief, concentrated moments of highly structured and sequenced instruction, facilitated by embedded narrative structures, and longer stretches of ambiguous and subjective player activity, during which emergent narrative would be generated. At first blush, these two types of narrative suggest different applications within a 3D-DGBL environment and, therefore, different approaches for developing this narrative. As embedded narrative is generally revealed at the successful conclusion of specific game levels and challenges, and as it normally serves as the structural loop through which all traces of individual player activity must eventually pass in order to develop the story arc of the game, it would seem appropriate to align this type of narrative with the teaching and testing of specific learning objectives in support of "explicit, principled educational goals and expected outcomes" (MLA Ad Hoc Report, 2007, p. 5). Embedded narrative could, returning to the example above, potentially assume the form of a prerendered or interactive cutscene showing the player how to operate a ticket vending machine and provide her with the necessary cognitive scaffolding to guide her through the process. On the other hand, emergent narrative, which is highly personal in nature and difficult to predicted in advance, would seem more amenable to incidental learning and the creation of third spaces for encouraging translingual and transcultural reflection. Narrative of this type could potentially be couched in NPC dialogue or in the functionality of game objects themselves, be more dependent upon subjective player interpretation and states of mind, and generate topics to be broached in later in-class discussions and debriefing sessions addressing the otherness of the game world. As the quality of both types of narrative varies dramatically, each supporting different types of player interaction with the game, it will be necessary to map their instructional agendas according to relevant instructional design and learning theories.

For example, embedded narrative most likely would utilize verbal and pictorial forms, coupled with

highly structured player interactivity and limited personal agency, which would necessitate its development in-line with cognitive theories of multimedia learning (see Mayer, 2005; Plass & Jones, 2005). These theories would be essential, among other things, for managing player split-attention (Ayres & Sweller, 2005), determining the correct balance of modalities in order to increase learning (Low & Sweller, 2005), and activating prior knowledge and advance organizers (Kalyuga, 2005). Although these theories would undoubtedly be beneficial for designing the emergent narrative of a 3D-DGBL environment as well, the unstructured and open-ended nature of this type of narrative seems to suggest that instructional designers must approach it differently than a "normal" multimedia environment, although emergent narrative – in its most basic form – still remains a combination of verbal and pictorial forms. Shelton (2007) proposes that a well-designed computer game would seek to align its gameplay, or emergent narrative, with the completion of specific learning objectives, so that "a correct balance of game-like attributes are included for motivation, but that the activities within the game are meaningful, and therefore exist as more than just a means to an end" (p. 112). Going a step further, Neville and Shelton (2009) categorize three types of virtual objects that can be found in a 3D-DGBL environment – bridging, false friends, and non-analogue – and suggest that the quality of these objects, and the manner in which students interact with them, lend themselves to articulating guidelines for designing meaningful instruction. Nevertheless, the conundrum persists: How does one design efficient and effective instruction in 3D-DGBL environments when *everything* is a potential learning situation, when it is *impossible* to predict which path the learner will take, and when *every* path is a valid course of study? And, finally, how can this type of gameplay be adapted for use in SLA contexts?

In this case, the conundrum reveals a possible solution: If everything presents a potential learning opportunity, and learning is a result of unique traces of player activity within a game system, then the most basic and granular component of this activity should be the basic building block of instruction, akin to what Nitsche (2008) describes as an "evocative narrative element" (p. 37). Such an approach does not seek to overturn the suggestions made by Dickey (2006) regarding larger narrative structures serving as instructional scaffolding, but rather seeks to take into consideration the interpretive latitude players will introduce into the game as they forge their own identities while interacting with a second language and culture. Reason for this approach is that player interaction with discrete virtual objects in the game, including NPCs, forms the individual links of longer and unique narrative strands, or player stories. Although the joining of these links is, with the noted exception of embedded narrative, largely contingent upon player activity within a gamespace, the *quality* of the links – and how they fit together in order to constitute a gamespace – rests firmly in the hands of the game designer. What is needed, therefore, is a blueprint or design rubric for these links to ensure that even open-ended player activity within a 3D-DGBL environment nevertheless maintains high levels of instructional integrity and can be organized around major explicit and principled educational goals. Such a rubric would be essential not only for designing the game itself, but also for formulating assessment and game debriefing strategies.

Reducing the instruction provided by a 3D-DGBL environment to its most basic links is in many ways similar to the ideas proposed by learning object design and sequencing theory (Bannan-Ritland, B., Dabbagh, N. & Murphy, K, 2000; Wiley, 2000a, 2000b), although increased player/learner agency, as already demonstrated, potentially muddies the waters with regard to how much instructional sequencing is actually possible within these environments. More research and development certainly needs to be done in this area, and the current essay, by looking at player/learner interaction with virtual objects as the basic instructional building block and cornerstone of student-generated narrative traces, is a step in this direction. To ensure that gameplay within a 3D-DGBL environment can be aligned with specific instructional objectives and that the successful completion of these objectives are both observable and measurable, either by qualitative or quantitative means, it is proposed that a modified performance objective based on the Dick and Carey systems approach model (see Dick, Carey, & Carey, 2001, pp. 120-139), or a similar model, be adapted as a design rubric for identifying key components of gameplay, aligning this gameplay with explicit learning objectives, and then programming this gameplay into specific game resources, understood to be either a virtual artifact or NPC. Player activity within the game world would configure these resources such, so that a unique narrative trace could emerge that could simultaneously also be framed within specific instructional contexts (see Figure 7). Table 1 describes this modified rubric, suggests design components that it would ideally entail, and formulates questions that its components should address in order to design more effective and efficient SLA instruction in emergent 3D-DGBL environment.

Finding the right proportion between instruction and gameplay will be the primary challenge facing developers of 3D-DGBL environments for SLA. A key component of successful instructional game design is the careful balancing of these extremes. On the one hand, a game that is simply an unsophisticated veneer of playful activity over a substantial substratum of instruction runs the risk of being interpreted as boring and pedantic. On the other hand, a game that is all play and no learning has little application in the classroom. By inserting too much instruction into embedded narratives, for example, a pattern of "play-learn-play" could

potentially evolve that runs the risk of becoming repetitive and predictable for the player/learner in addition to disrupting the flow of the gaming experience (Csikszentmihalyi, 1990, 1996, 1998). The primary purpose of embedded narrative, after all, is to advance the story presented by the computer game. If embedded narrative does not seem to serve this purpose, students may opt quickly to skip over these instructional components in order to resume gameplay. Instead, it may be best to think of computer games as simulations of the real world, where people encounter emergent problems and then develop the skills, or reconfigure existing ones, to deal with these problems. Learning, therefore, would perhaps ideally take place outside of the gaming environment – in the classroom or on a game-related website – where students could be debriefed on gameplay in a manner similar to problem-based learning (PBL) approaches, exchange strategies for dealing with game-based challenges, and practice new vocabulary and grammar structures (Steinwachs, 1992; Thiagarajan, 1993).

In a nutshell, the creation of all game resources would center around the concept of a performance objective, or “a detailed description of what students will be able to do when they complete a unit of instruction” (Dick, Carey, & Carey, 2001, pp. 123). Each resource in the game – regardless of how small or large, whether it is embedded or emergent – must be considered a potential unit of instruction. This instruction would be programmed into the game resource, thereby influencing how it functions within the virtual game world and generating instructional narrative based on the quality of player/learner interaction with the resource. The example of narrative traces cited above demonstrates how the design rubric proposed in this essay could potentially be applied toward developing these resources. The traveler's guide would be a *primary resource* in that it contains information detailing how the level objective, purchasing a subway ticket from the vending machine, could be successfully completed. Level objectives, of course, could be seen as primary resources for the game itself. The traveler's guide, however, could also be a *secondary resource* since it may relate incidental information about the foreign language or culture that is not necessary for completing the level objective. For example, the player/learner may discover that city guides are helpful to a traveler and can be found at newspaper stands in the foreign country. *Behaviors* clarify what the player/learner must do in order to acquire or access the resource, such as purchasing the guide for a certain amount of money, and detail the order in which this action will occur. The player/learner may, for instance, first be required to pick the traveler's guide up off a table and bring it to a cash register for purchase. The player/learner will, of course, need to have sufficient money to purchase the guide, a prerequisite which, among others, will be articulated in the *conditions*.

How the player/learner demonstrates mastery of a particular unit of instruction, or game resource, will be described in the *criteria*. Generally, subsequent game activity demonstrates this mastery as player/learners do not advance to subsequent levels in the game if they do not manage primary resources effectively. However, specific in-class debriefing strategies or assessment routines must also be developed for the incidental learning that may occur through player/learner interaction with primary and secondary resources. The *language* aspect of the rubric will determine what modalities of the target language (*i.e.*, printed or spoken) will be used to develop the resource, in addition to the grammar and vocabulary that will be required. Ideally, this grammar and vocabulary should be covered in-class before a player/learner initiates the game, although non-intrusive just-in-time (JIT) instructional strategies, which can be inserted directly into the game, also need to be formulated. For example, the game character played by the player/learner could be equipped with a personal digital assistant (PDA) device that contains a dictionary for the target language and plays instructional grammar videos that are streamed off a remote server on demand. Both *society* and *culture* will reflect the ways in which the game resource could be framed in authentic sociocultural contexts and help articulate the manner in which these contexts would potentially influence the functionality of the resource. The traveler's guide may, for instance, stigmatize the player/learner as a foreigner, affecting subsequent gameplay, or the player/learner may need to purchase the guide from a representative of an minority ethnic group working at the stand. The *connections* aspect of the rubric, which is essential for making challenging and immersive gameplay, describes points of contact that the developed resource has to other resources in the game and helps to spread instruction necessary for mastering a specific performance objective across these resources. The traveler's guide, for example, may inform the player about purchasing a subway ticket from the vending machine, but refers the player/learner to the tourist information office for specific inquires regarding the types of tickets that can be purchased.

## Conclusion

Carefully-designed 3D-DGBL environments have a place in the foreign language classroom because they are able to simulate real-world sociocultural spaces, allow playful and non-threatening interaction with these spaces, and permit player/learners to experiment with questions of personal identity within a framework of shifting subjectivities. On account of these affordances, 3D-DGBL seems to be a promising learning platform that allows students to develop sophisticated mental schemata for handling context-specific challenges requiring them to apply knowledge of a second language and culture toward the solution of specific real-world problems. In designing these environments and applying them in a curriculum, however, it is important to bear in mind

that player/learner agency may occasionally work at cross purposes to the intentions of the game designer. Although the dramatic tension created by embedded narrative structures such as a game backstory and level challenges can function as a mental scaffolding to guide the player/learner at the macro-level, a game is, ultimately, composed of individual and linkable elements at the micro-level. How these elements are encountered and experienced is as unique as the players of the game themselves. Seeing to it that, at the very least, game objects are inserted into the virtual environment with forethought and an eye directed towards their instructional integrity will hopefully ensure that, even though in-game player activity is impossible to predict in advance, the collective experiencing of these objects will engender overall gameplay that is meaningful, engaging, and instructional.

This essay seeks to articulate a theoretically-grounded albeit practical approach for designing 3D-DGBL environments by comparing descriptions of narrative as detailed in theories of situated cognition, sociocultural approaches to SLA, and game studies. Although such an approach is useful in that it provides a point of origin, a place from which to begin the development of these environments, it is inevitable that the theoretical suggestions made here will need to be refined based on the empirical findings gleaned from the design and testing of actual 3D-DGBL environments in SLA contexts. This winnowing process is essential and, in any case, it is hoped that the essay will serve as a catalyst for future research, development, and thought. Like the iterative feedback loop the player experiences in game environments, the continual process of researching and developing 3D-DGBL environments will undoubtedly be instrumental in helping to form the identity of language studies in the 21st century.

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## Figure Captions

Figure 1: Image render of 3D models currently being developed for use in *The DigiBahn Project*.

Figure 2: Screen capture showing Blender (<http://www.blender.org>), the open source 3D content creation suite being used to develop game models for *The DigiBahn Project*. Game programming will be done in Unity 3D (<http://unity3d.com>), an integrated graphic authoring tool for creating 3D video games.

Figure 3: Screen capture from *Half-Life 2* showing Train Station Square in City 17. Particularly noteworthy is the game's use of lighting, shading, physics, and architecture to generate immersive narratives for the player to configure.

Figure 4: Graphical depiction of the feedback loop found in 3D game environments, showing the interrelation of gameplay, narrative, and internal intentional states of the player.

Figure 5: Graphical depiction of the narrative trace for Player 1.

Figure 6: Graphical depiction of the narrative trace for Player 2.

Figure 7: Player activity within a 3D game world would configure game resources, resulting in a unique narrative trace that could be aligned with specific learning objectives.

Table 1: Design rubric for developing performance objectives in 3D-DGBL environments.



Figure 1

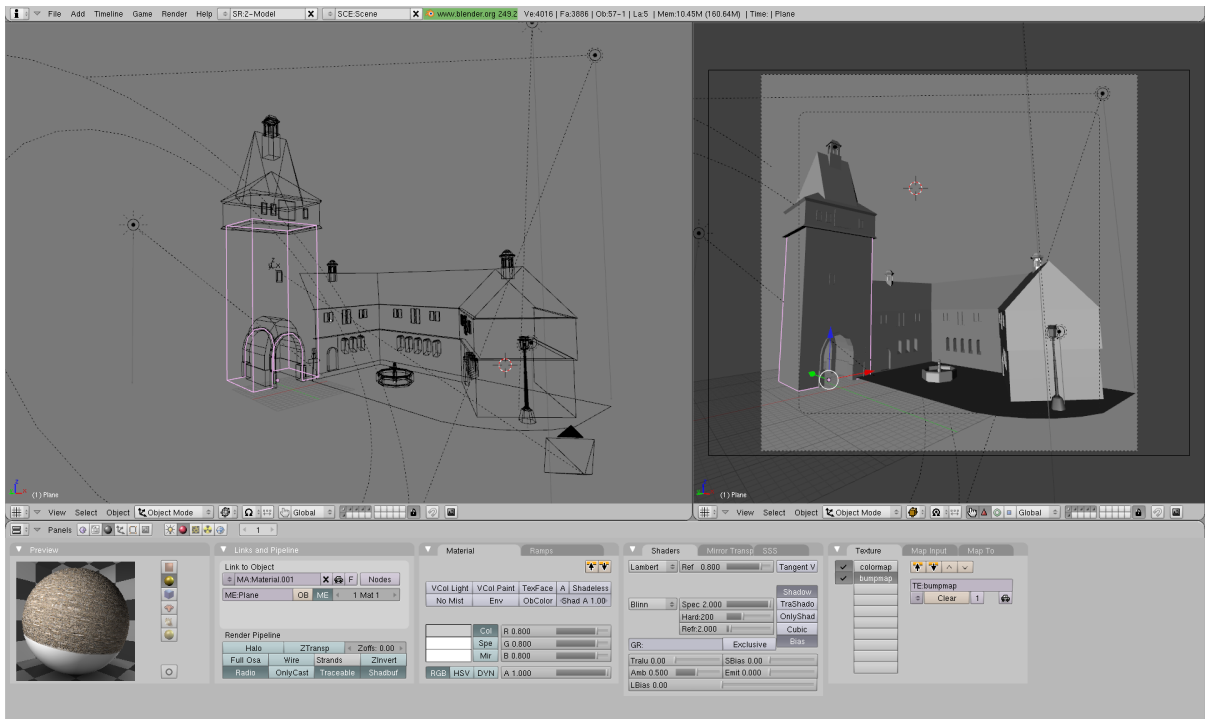


Figure 2



Figure 3

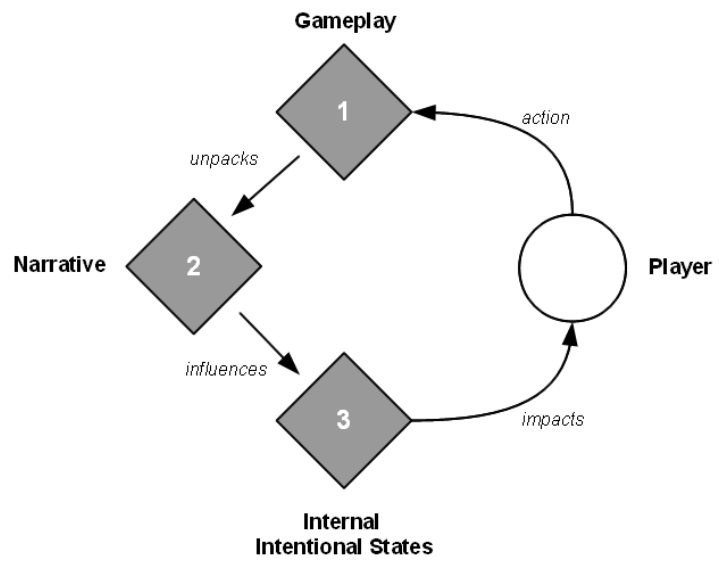


Figure 4

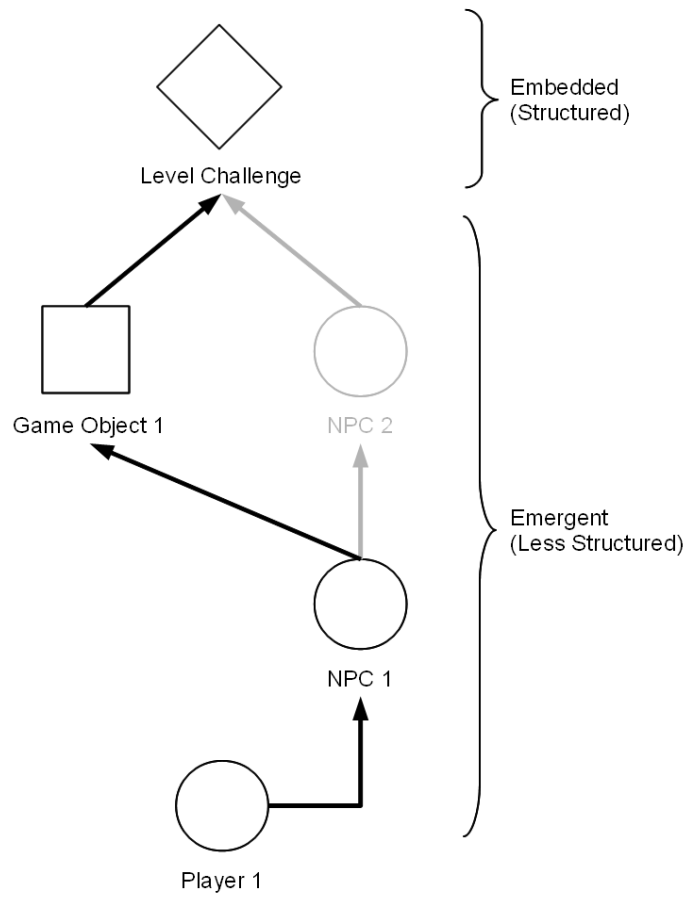


Figure 5

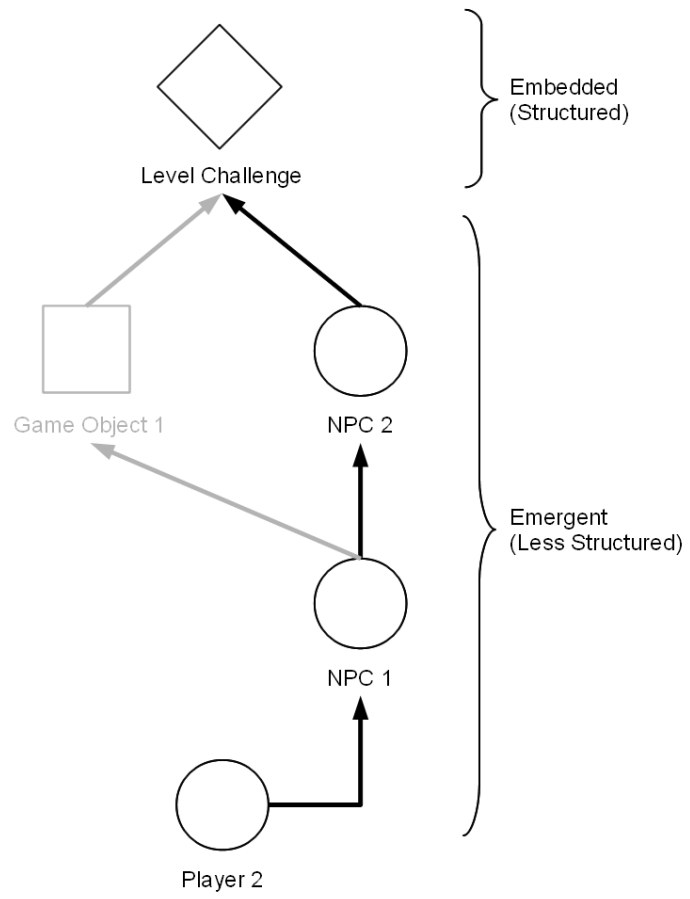


Figure 6

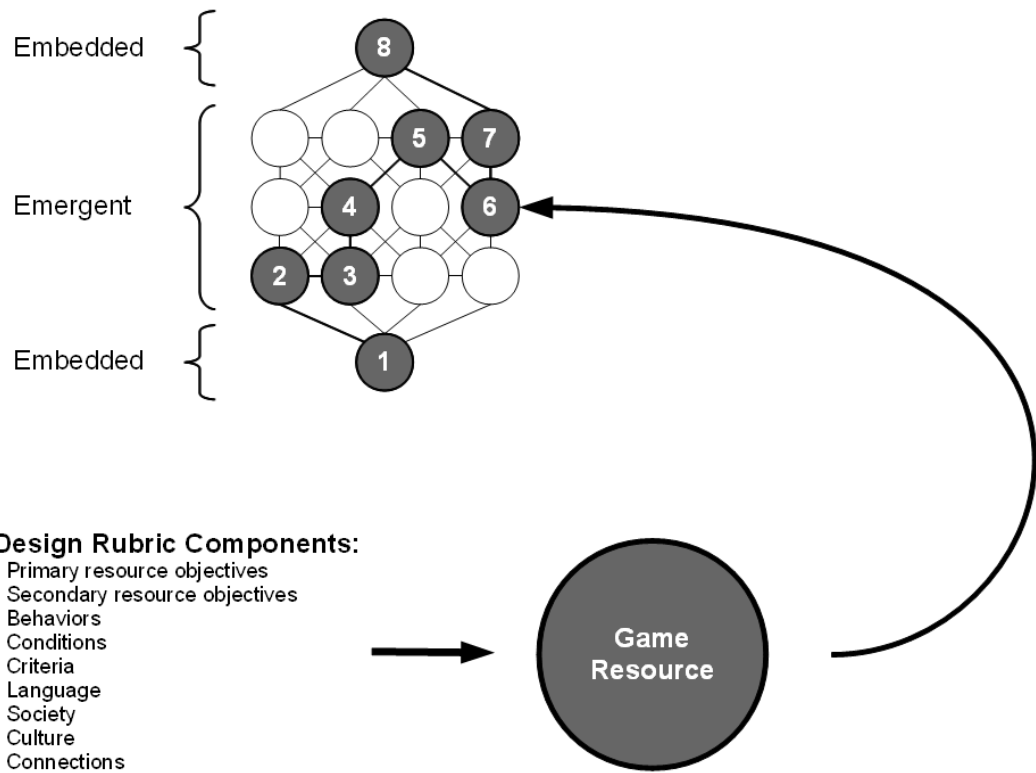


Figure 7

*Table 1. Design rubric for developing performance objectives in emergent 3D-DGBL environments*

<b>Design Component</b>	<b>Design Questions</b>
<b>Primary resource objectives</b>	<p>What will the player/learner be able to do after interacting with the game resource?</p> <p>How will this interaction bring the player/learner closer to completing or solving a level challenge?</p>
<b>Secondary resource objectives</b>	<p>What incidental information could the player learn through interacting with the game resource?</p> <p>What additional player behaviors could this information support?</p>
<b>Behaviors</b>	<p>What must the player/learner do in order to interact successfully with the game resource?</p> <p>What are the steps or procedures for successful interaction?</p> <p>How will other game resources be utilized to support interaction with the resource in question?</p> <p>In what manner will the game keep track of player/learner interaction with the resource?</p> <p>How will the game measure interaction with the resource?</p>
<b>Conditions</b>	<p>What conditions must the player/learner satisfy before interacting with the game resource?</p> <p>What must the player/learner know in order to interact with the game resource?</p> <p>How can the player/learner develop or acquire this prior knowledge?</p> <p>Will the game provide just-in-time (JIT) instruction to help the player/learner interact with the game resource?</p> <p>What form will this JIT instruction assume?</p>
<b>Criteria</b>	<p>What constitutes successful interaction with the game resource?</p> <p>How will the player/learner know that interaction with the resource has been successful?</p> <p>How will player/learner performance be evaluated?</p> <p>What classroom debriefing strategies can be used to foster classroom discussion of the game resource and its constituent parts?</p>
<b>Language</b>	<p>What language modalities will the game resource employ?</p> <p>What potential difficulties could the language modalities present the player/learner?</p> <p>How will the game manage these difficulties?</p> <p>What new grammar topics will be covered?</p> <p>What new vocabulary will be introduced?</p> <p>How will JIT instruction support the learning of the grammar and vocabulary topics?</p>
<b>Society</b>	<p>What are the social contexts in which the game resource will be situated?</p> <p>How will these social contexts enable or limit gameplay?</p> <p>Can the game encourage the transfer of player/learner performance to related social contexts?</p> <p>What potential cognitive disequilibrium might the player/learner encounter within the social context?</p> <p>How will the game or classroom debriefing strategies manage this disequilibrium?</p>
<b>Culture</b>	<p>What are the cultural contexts in which the game resource will be situated?</p> <p>How will these contexts be represented?</p> <p>How will these cultural contexts enable or limit gameplay?</p> <p>Do points of friction exist between the cultural contexts simulated in the game and the player's own culture?</p> <p>How will the game or classroom debriefing strategies manage these points of friction?</p>
<b>Connections</b>	<p>What types of connections does the game resource have to other resources?</p> <p>How will the player be made cognizant of these connections?</p> <p>How much information will the game resource provide to solve a level challenge?</p> <p>How much information will be embedded in other resources?</p>