An Innovation-Oriented Game Design Meta-Model Integrating Industry, Research and Artistic Design Practices

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Abstract

The distinction between implicit and unselfconscious design cultures on one hand and explicit, self-conscious design cultures on the other provides a principle for interrelating a variety of game design approaches within a coherent game design meta-model. The design approaches in order of increasing design self-consciousness include implicit design, ‘cookbook’ design methods, taxonomy and ontology-based game design, theory-driven design and formalist reflexive design. Implicit design proceeds by copying existing examples of game designs, while ‘cookbook’ methods generalize from examples to create lists of design heuristics. Taxonomy and ontology-based game design is based upon more systematic models of the types, features, elements, structure and properties of games. The theory-driven level involves the design of game systems to facilitate game play motivated by cognitive, scientific and/or rhetorical theories of game affect and functionality, or incorporating technical innovations providing the basis for new game mechanics and experiences. The formalist level represents the application of reflexive contemporary artistic perspectives to games, resulting in games that reflect upon, question or reveal game form. In placing these different approaches within a hierarchy of increasing self-consciousness of design practices, the meta-model provides a clear account of the roles of research and artistic methods in game design and innovation, providing a foundation for more explicit design decision making and game education curriculum development integrated with higher-level research.

Keywords: game design, methodology, pedagogy, innovation, research, art.

Introduction

This paper presents a meta-model describing and interrelating different approaches to and methodologies for game design. Motivations and questions behind the development of this meta-model include the need for more systematic, advanced pedagogical methods for teaching game design within specialized game education programs. A good pedagogical framework must be able to relate games to the history of other media, to be able to account for the relationships between viewing games as an industrial design activity on one hand, and as a contemporary artistic medium on the other. Games can be designed not only for entertainment or artistic purposes, but also for specific rhetorical purposes (e.g. advergaming), or to embody specific theoretical principles aimed at achieving particular affects within players (e.g. for therapy or to facilitate targeted modes of immersion). A high level view of game design needs to integrate these different design contexts and motivations. It is also necessary, specifically

from a pedagogical perspective, to develop approaches to game design that facilitate the evolution of game forms beyond games that are currently available, in order to create new modes of experience, to address new markets and applications, and to deepen our cultural understanding of game form and function. A pedagogical framework for game design education must also foster creativity, leading students to be able to think ‘outside the box’, as well as integrating education, industrial design practice and formal research as it relates to design.

The meta-model presented in this paper is proposed as one way of meeting these requirements. The paper first presents a foundational distinction articulated by Alexander (1970) between self-conscious and unselfconscious design cultures. Based upon this distinction in mind, we then present the overall meta-model that integrates implicit game design methods, with what we call ‘cook-book’ design approaches, game design patterns and game ontologies, theory-driven design and formalist design. Each of these approaches is then described in more detail, including discussion of its relationships with the other design methods. The meta-model has been used as the foundation for an advanced game design course, and some of the resulting design concepts are described. The purpose of the meta-model is certainly not to provide any kind of substitute for the creativity of designers. Rather, it is a tool for facilitating, opening up and perhaps amplifying that creativity, based upon the general principle that representations provide amplification of human cognitive capacities, as described by Harth (1999). While the model is being used to facilitate pedagogical processes that encourage more creative design by novices and to speed up the development of design competence, it also clarifies the relationships between industrial game design practice and different forms of research, contributing to ongoing discussions about the relationship between research and industrial practice in game development.

Game Design

Before going into the detailed discussion of design methodology, it is useful to present a preliminary representation of the general objects, or outcomes, of game design, as shown in Figure 1, based upon the driving concept of the game play experience, a consideration of what remains the same when a game is realized in different ways, and what design elements change in different implementations of ‘the same’ game. These are the various elements of form representing the final outcome of design and that shape and constitute the designed artifact. In this model, game play is at the center since this represents the core and overall goal of game design, being the design of the space of possible interactive experiences for players. This may be more or less open, from restricting the player to very limited possibilities (e.g. in a simple game like Tic-Tac-To) to very open games having a lot of scope for players themselves to shape their own experiences (e.g. live-action role-playing games, or larp). In all cases, the scope for players to vary their game play within the constraints of a particular game system is always at least implicitly a design decision. Of course, players may use a game system in ways that do not constitute playing within the system (e.g. a game to see who can throw a computer game CD into a hat!), but the game design itself includes, implicitly or explicitly, a scope beyond which play no longer takes place within the designed game. It is the scope of play intended by designers that drives the design process.

Driven by the target game play, the next priority in game design is the design of a logical game system and elements needed to support a space of designed play experiences. Hence the target game play provides a requirement specification driving design of the logical game system and elements. The logical game system and elements include:
- game rules that specify legal moves that players may make, the consequences of moves, win/lose criteria, etc.

- game objects are the things within the game that are referred to by the rules and may be manipulated by the player and/or game system; objects may be active or passive, and their specification can include attributes relevant to game play and referred to by the rules and game system.

The game system might include media-specific procedures, but the rest of the logical game system and elements will often be transferable across different media. For example, sports games specify particular rules, game objects (such as bats and balls), player roles and a game space (such as courts or fields); however, there are many computer versions of sports games where these elements are intact, although the system of play and the nature of the play experience are different. To the extent that the system and the play experiences differ across different media, these are examples of different games, but to the extent that the game rules, objects, player roles and game space are the same, then they are the same game: the identity of a game follows from the (variable) scope of elements taken as constituting that identity.

Once the logical game system and elements are specified, it is possible to undertake the design of the game media components. This may include 2D and 3D graphics, animations, video, audio, lighting, costumes, sets or stages, interfaces, technology and infrastructure. For
computer games, costumes, sets or stages are virtual, and the game space may be organised into game levels within an overall virtual game world. For physically staged games, this will be physical elements, such as the costumes of larpers or the uniforms of sports players. Within this layer design techniques from established design fields may be applied, but always in terms of meeting the gameplay-driven requirements of the game system. Hence established methods address the design of media elements, while game design as such is concerned with the inner core of gameplay and the design of the logical game elements and system required to facilitate gameplay.

Outside the areas of artifact design, game design also has a bearing upon the context of play. For example, a board game designed for a context such as a family home makes assumptions about what is possible within that context (e.g. a clear table around which six adults may sit); if the context does not accommodate those assumptions (e.g. no room for a larger table) then the context must be modified if the game is to be played (e.g. other furniture is moved out). Hence the game design implies or specifies requirements for features within the context of play, amounting to a degree of context design that may be satisfied either by selecting a suitable context or modifying a context to render it suitable. Contextual requirements are well understood for computer games and actively analysed by the designers of console games. Contextual factors are a significant challenge to overcome for the widespread commercialization of some new game forms, such as augmented reality games or technology enhanced games; barriers here include cost, an unprepared market, and the need for some kind of bootstrapping process by which increasing markets can drive costs down. For this reason, contextual design can have a much greater impact for new game forms having poorly established or supported context requirements.

Self-Conscious and Unselfconscious Cultures

The american architect Christopher Alexander (1970) makes a useful distinction between implicit design within an unselfconscious design culture and explicit design within a self-conscious design culture. While Alexander is specifically interested in architecture, these distinctions will be applied here to processes of game design. This may be regarded by some as a controversial application of what may be seen as a rather dated distinction. Our answers to this are firstly, that the distinction provides a useful heuristic for interrelating different approaches to game design; as a heuristic it is a simplification, but one that we have found to be effective in practice for stimulating more creative design outcomes. Alexander’s distinction is a simple binary one. We have taken it further to distinguish degrees of self-consciousness in order to organize and interrelate what may be regarded as different approaches to design. This organization is just that, a way of approaching and regarding design perspectives. We do not claim that it is more or less correct than other ways of organizing and interrelating approaches to design may be, although we have not yet seen many other high level models, and we argue for the usefulness of is particular model. Secondly, in Architecture the academic discourse around design is well established and mature. In game design, it is not. It should not therefore be surprising that a metadiscussion about game design approaches should perhaps look back within the history of other design disciplines for distinctions that might be used in the early stages of a discourse that will later gain comparable sophistication.

Alexander characterizes an unselfconscious culture as one in which there is little thought about design as such and there are no general principles of design; rather, there is a tradition of right and wrong ways of doing things and practitioners learn to imitate by practice, the
same form being learned over and over again. Creation involves the repetition of patterns of tradition because those are the only ones known. There is no particular interest in new or individual ideas, and there are no written records. Concepts and the language of self-criticism are too poorly developed within an implicit design culture to make significant critical discussion possible. A novice learns by very gradual exposure to the craft, being guided by sanctions, penalties, reinforcing smiles and frowns, etc. Creation is based upon implicit (unmentioned) and specific principles of shape; unspoken rules, of high complexity, are not made explicit, but revealed through the correction of mistakes.

This mode of creation is very typical of longstanding creative practices, such as those within traditional cultures for building houses or making artifacts of different kinds. Alexander (1970) characterizes the implicit design methods of an unselfconscious culture as methods that result in highly successful forms, but only if the rate of change of the functional context of creation is comparatively slow. Designs are then adapted to slowly changing contexts by a series of very small scale changes.

In many ways, at least until very recently, the commercial game industry has shown many of the features of an unselfconscious design culture as described by Alexander. This is especially the case for games having stable feature sets, comprising standard design features within game genres such as strategy games, first-person shooters and role-playing games. Would-be designers of such games have been faced with a bottom-up model of the road to professional design that begins with hard-core gaming. The gamer might then move on to modding and scripting as an indicator of commitment and nascient design talent. The entry point for a would-be designer within a game company might then be as a tester. After demonstrating some talent for testing, it might be possible to gain a position as a level designer. The career path then goes from level design to game designer within a team to becoming a lead designer for new games. All along the way expertise is developed largely by imitation, trial, correction and experience. There is little innovation involved within design practices throughout this process and the road to becoming a fully credible design specialist may take very many years to travel.

This model of breaking into the game industry applies not only to design roles, but also the development and producing roles (e.g. see http://archive.gamespy.com/articles/january03/education/day2/). While the model may work for comparatively stable game genres, it is not suitable under conditions where design demands/functions are evolving quickly, or when higher levels of innovation are required, such as when the market is bored with established forms, when a company or publisher wants to explore uncharted territory, or to keep up with and take advantage of changing technologies. It is also unsuitable when the training of designers must be accelerated, e.g. to keep up with the demands of an expanding industry. It is therefore not surprising that, especially over the past decade, there has been an increasing development of self-consciousness in game design.

Alexander (1970) characterizes a self-conscious culture as one in which form-making is undertaken by explicit and general (academic) rules and principles. Education is formalised, based upon instructions and teachers who train pupils, and novices learn much more rapidly based upon general principles. Teachers engage in a general process of trying to make design rules explicit, condensing knowledge that was once laboriously acquired through experience. Self-conscious cultures arise in circumstances where new purposes occur all the time and it is not enough to copy old patterns. In this situation design education is based upon explicit
general principles of function, facilitating innovations and modifications as required, although
the dynamic nature of the design context means that self-conscious design tends to lead
overall to less good fit.

Alexander (1970) describes how as a self-conscious design culture develops further, change
for its own sake becomes acceptable. Culture changes too rapidly for adaptation to keep up
with it and factors sustaining equilibrium drop away. The master craftsman takes over the
process of form-making and inventiveness becomes valued as a way of distinguishing
craftsmen/artists, leading to the cultural perception of the designer as a star. Specialisation
underlies the establishment of design academies, and the academies make principles explicit,
making them available for criticism and debate. Debate requires justification, leading to the
formulation of general theories, principles and rules. Questioning leads to unrest, which leads
to formal innovation and further self-consciousness.

Self-conscious design culture is concerned with both the design education of novices and
explicit, self-conscious debate among established and experienced designers. One of the
distinctions of experienced and expert designers (as with all forms of expertise) is an
increasing *implicitness* of knowledge, with ongoing analytical processes oriented towards
making that implicit knowledge more explicit. Hence explicit design knowledge accelerates
and facilitates the ongoing development of expertise, but it is always very far from fully
representing that expertise.

**Game Design Methods and Degrees of Self-Consciousness**

The distinction between unselfconscious or implicit design cultures and self-conscious or
explicit design cultures provides a foundation for interrelating different methods of game
design. Different methodological perspectives or approaches are described in terms of their
degree of self-consciousness the following subsections.

**Implicit Game Design**

Game design within an unselfconscious design culture proceeds primarily by copying. As
Alexander (1970) notes, this really amounts to selection rather than design. Highly
conservative development cultures fall largely into this mode of operation. Within this
culture, a design might be developed based upon a set of known examples, where the game
design document, necessary as a social record of design decisions, really amounts to a list of
features selected from a range of possibilities understood from past games within the tradition
of the genre. For example, if a developer wishes to make a ‘fantasy RPG’, there are highly
conventionalized precedents for combat, magic and trading (inventory) systems. A
conventional combat system may provide precedents for character features, hit points, armor
and attack values, together with rules for how these parameters are interrelated to generate
outcomes from combat interactions. The fictional genres of fantasy, in literature, cinema and
games, can provide predefined character archetypes, races, functions (fighter, magician,
cleric, etc.) from which selections can also be made. Alternatively, new fictional elements
may be introduced, such as a unique world with its own kinds of races and character classes,
with the game mechanics being nevertheless selected from game genre conventions. In this
case innovation is very much in the level of small scale but perhaps extensive features, such
as the design of visual styles and graphics, design of specific weapons and armor, or particular
novel character classes or races having different combinations or parameterizations of
standard features and/or capabilities. Higher levels of innovation created by genre crossover still amount to a selection of features from established designs within genres.

The persistent popularity of genre productions makes implicit design within genre traditions a viable commercial option. The primary requirements for innovation include the need to keep up with increasing technological capacities in target machines, although the impact of this is most directly felt in the nature and requirements placed upon game media assets (animation sequences, mesh models, textures, etc.). What the implicit culture is not so good at dealing with are the rapid education of designers (it takes time to develop an extensive experience of playing and then designing games within a genre), to create new modes of experience within genres for perhaps an aging player base that is becoming restless with the same modes of play, and for creating innovations in the basic form of game mechanics for the sake of attracting new and different kinds of players.

‘Cook Book’ Game Design

Design ‘cookbooks’ are compilations of design ‘recipes’ consisting of rules, principles and heuristics. Cookbook approaches represent the first step in making design knowledge explicit and in making the design process self-conscious. A good example is Barwood’s ‘400 design rules’ project (Barwood, 2001, and Barwood and Falstein 2002; see also http://www.theinspiration.com/400_so_far.htm). Examples of rules from Barwood’s collection include: Maintain Level of Abstraction, Make Subgames, Let the Player Turn the Game Off, Maintain Suspension of Disbelief, Differentiate Interactivity from Non-Interactivity, Make the Game Fun for the Player, not the Designer or Computer, Provide an Enticing Long Term Goal, etc.. Cookbook elements are a substantial part of many game design publications (e.g. Rollings and Adams, 2003, Oxland, 2004, Salen and Zimmerman, 2004, Novak, 2005, Rouse, 2005, Bateman and Boon, 2006).

Cookbook approaches abstract from many specific examples of games to compile a superset of design features, options and principles. Cookbook design principles may be used as a foundation upon which more self-conscious approaches are founded, and many game design handbooks present more theoretical material as a context or justification of basic cookbook principles (a notable example being Salen and Zimmerman, 2004). What design cookbooks do not address in any depth are questions such as why certain design rules work, what it means to for them to work, what the inner motivations and rewards of game play might be, or how to design games for which there are not well understood games that can function as models to base design upon.

Game Taxonomies and Ontologies

The development of clear taxonomies and ontologies of game elements constitutes another step in rigour, clarity and comprehensiveness in the process of making game design self-conscious. A taxonomy can be understood as a system of named and defined classes or categories and their subclass/superclass relationships. An ontology can be understood as a taxonomy with the addition of class properties and relations between classes. In this discussion the terms tend to be used interchangeably, although in general an ontology provides a more detailed description of the conceptual structure of a domain than a taxonomy does. An ontology might be represented using i) a vocabulary of terms denoting ontological concepts, ii) definitions of those terms, that may provide criteria of their applicability, and iii)
a specification of how concepts are related, imposing structure on the domain and constraining the meanings of terms.

Within the general development of game design theory, increasing self-consciousness requires the development of game ontologies for discussing the forms and elements of games and raising the structure of the conceptual domain of games into greater awareness. Numerous proposals have been made for this, including the high level taxonomy proposed by Lindley (2003, 2005) that identifies basic distinctions between simulations, games and narratives as alternate formal systems being associated with respectively increasing time scales in the design process; simulations are concerned with modeling tick by tick (or frame-by-frame) changes, games with modeling player-controlled actions at intermediate time scales, and narratives being concerned with the largest scales of time structure. Lindley (2003) further distinguishes the orthogonal classification dimensions of fact/fiction representational functions and physical/virtual staging strategies for games. Aarseth et al (2003) propose a taxonomy based upon a variety of formal (i.e. non-narrative and non-representational) characteristics covering space (perspective, topography, environment), time (pace, representation, teleology), player structure, control (mutability, savability, determinism), and rules (topological, time-based, objective-based). Klabbers (2003) presents a taxonomy of game pragmatics, i.e. a taxonomy of the external functional application domains of games, game form and simulation, including business, administration, education, environment, health care, human services, international relations, military, religion, technology, human settlements and imaginary worlds. Foci of interest (including theory and methodology, instrumental design, research, training and education, and entertainment) are then broken down in a different dimension and themes (including competence, communication, knowledge/skills, management/organization, policy and fun) in another.

Björk and Holopainen (2005) present a taxonomy of the high level aspects of games, presented as a game component framework that includes: Holistic Components dealing with aspects of the game regarded as a whole (game instances, game sessions, and play sessions), Structural Components that are the basic parts of the game manipulated by the players and the system (including an interface, game elements, players, a game facilitator and game time), Boundary Components that limit the activities of a player of a game either by only allowing certain actions or by making some actions more rewarding than others (including rules, modes of play, goals and subgoals), and Temporal Components that describe the time flow of a game (including actions, events, closures and subclosures, end conditions and evaluation functions).

The classic work of Caillois (1958) presents a taxonomy of forms of play based upon an analysis of Latin terminology, including *agon*, based upon competition, *alea*, based upon chance, *mimicry*, based upon simulation and the kind of play associated with acting a role in a theatre production, and *ilinx*, based upon vertigo, “an attempt to momentarily destroy the stability of perception and inflict a kind of voluptuous panic upon an otherwise lucid mind”. Caillois (1958) also discusses the distinction between *Paidia* as uncontrolled, free, improvised and ecstatic play, and *ludus*, which is play tightly bound up with arbitrary, mandatory and often tedious rules and conventions. Between paida and ludus there is a continuum between which there are degrees of variation, from total freedom to heavy but arbitrary constraint.

Game design patterns are another form of game ontology. The concept of game design patterns has been developed by Kreimeier (2002), Björk and Holopainen (2005) and Kirk (2005). Björk and Holopainen (2005) define game design patterns as “semiformal interdependent descriptions of commonly reoccurring parts of the design of a game that
concern gameplay”. Game design patterns are essentially higher-level structures of game elements that might be described by component-oriented taxonomies, together with interaction patterns. Björk and Holopainen (2005) present 200 game design patterns, including the familiar patterns of Paper-Rock-Scissors, Save-Load Cycles, Enemies, Game World and Combat. The balance between interaction structure and other contents of game design patterns, as they have been articulated to date, varies. It is an issue of ongoing concern to validate the usefulness of the existing patterns within different contexts, and to further refine them or specify new patterns for purposes for which the currently identified patterns are not adequate.

Game taxonomies and ontologies are useful for describing game elements and design concepts in a way that is more systematic and comprehensive that cookbook compilations of design knowledge, also addressing structural features missing from cookbook approaches. However, they are not in themselves adequate for explaining, justifying or motivating design decisions. The next level in design self-consciousness must address these issues of why specific design choices are made. This requires the development of empirically validated theoretical perspectives by which game designs expressed according to suitable taxonomies and ontologies can be interpreted and/or motivated.

Theory-Driven Game Design

Theory-driven design refers to the next stage in the explicit and self-conscious development of designs in which design elements, principles and/or patterns are selected according to clear and conscious criteria. Those criteria are regarded as constituting or deriving from some form of motivational or interpretative theory. Relevant theories may include rhetorical theories of how a design can achieve changes in the beliefs, behaviors, consciousness or ways of perceiving of players, scientific theories about player motivations, the function of games and affects of play upon players, and general theories, which may be theories about any aspect of the form, structure, history, purpose or meaning of the world or things within the world.

Rhetorical Game Design

Rhetorical theories amount to theories about how a design can produce specific attitudinal, epistemic, behavioral or perceptual changes in players. Games designed from a rhetorical perspective include so-called ‘serious games’ (e.g. see http://www.seriousgames.org/) or third-party games, i.e. games designed to achieve purposes for some agency other than the players and the developers. Third party games include games that function as advertising, political games, social games, educational games and ideological games. There are many examples of rhetorical games. America’s Army (http://www.americasarmy.com/) is essentially an advergame commissioned by the US defence department and designed to convince players to join the US army. Howard Dean for Iowa (http://www.deanforamericagame.com/) is a political game supporting Howard Dean’s US presidential bid. Foreign Ground (http://www.gamespot.com/news/6137237.html) is an educational game designed for training defense personnel on peacekeeping missions. Many games have been developed for health education (http://www.gamesforhealth.org/) and for making various kinds of political points or statements (see, for example, http://www.watercoolergames.org/archives/cat_political_games.shtml).

Although many rhetorical games have been developed, the theory behind the rhetorical function of games is not yet very advanced. A deeper understanding of the rhetorical
functions of games and game play requires deeper and more scientific or empirical study of game functions and player affects.

**Scientific Game Design**

*Scientific theories* may address many aspects and levels of game function and affects. This category is distinguished from the previous category of rhetorically motivated design in the adoption of scientific methodology in understanding game affects. Of course, rhetorical game designs could also base their design principles upon scientifically studied design effects, in which case rhetorical design and scientifically motivated design are the same thing. A number of studies of game play have investigated emotive issues such as game addiction (Fischer, 1994, Griffiths and Hunt, 1998, Salguero and Morán, 2002) and correlations between computer game play and violent behavior (Ballard and Weist, 1996, Griffiths, 1999, Anderson, 2004, and Smith, Lachlan and Tamborini, 2003). In order to more fully understand how game play can change players, and to support much more specifically targeted game design in terms of player affect, more detailed, fine-grained studies of psychophysiological and neurological responses to game play are required (e.g. Ravaja et al, 2005, Mathiak and Weber, 2005). The high level context for scientific studies might be regarded as the question of how player characteristics (personality, aptitudes, motivations) together with specific design features and play circumstances result in measurable and identifiable psychological and physiological changes during and perhaps following game play, where those changes might vary from very temporary changes to permanent changes. Cognitive, psychophysiological and neurological studies of game play hold the potential to reveal the details of cognitive and emotional processing that lay behind player engagement and immersion in game play, and unravel the uninformative concept of ‘fun’ into much more specific factors of motivation, attention and cognitive task performance in relation to different patterns and characteristics of game design features.

Scientific theories of game engagement and affect can provide deeper foundations for designing the rhetorical functions of games. They can also allow games to be designed for various other targeted effects. For example, games have been found to function effectively in therapeutical applications, such as the treatment of phobias (Robillard et al, 2003). A deep understanding of the effects of game play upon players holds the potential for the design of games that achieve particular effects of cognitive reprogramming. Of course, there are ethical considerations in this. However, implicit design or design with limited self-consciousness holds the danger of achieving these kinds of effects in a completely unconscious way on the part of designers and players. Articulating a well-developed science of gaming moves game play effects into the foreground of consciousness for explicit critical analysis of game functions. This certainly does not mean that scientific theories of game design should only be used for third party or rhetorical functions, since those theories can also support more informed design of the principles and affects of entertainment products.

*Time Frames of Scientific and Technical Research*

A notable aspect of scientific research is that it can also be regarded in terms of levels of innovation, as depicted in Figure 2 (focused upon industrial and technical research in the case of the bottom two levels), analogous to the levels of self-consciousness involved in design innovation. Within this model:
Basic research, or blue-sky research, is the pursuit of new knowledge without any assumptions about what it might lead to. This is knowledge for its own sake. In general (but not always) basic research can be expected to have a long time frame to the development of clear results, e.g. 10+ years, with even longer times being required to generate practical applications founded upon these results. Research into the molecular foundations of neural processes falls into this category.

![Levels of Scientific Research and Development Innovation](image)

Figure 2. Levels of Scientific Research and Development Innovation.

Strategic research is the pursuit of new knowledge that might in principle have practical applications but without a precise view of the time scale or nature of the application. Strategic research will generally have a mid- to long-term time frame to the development of clear results or practical applications, e.g. 5 to 10 years. A project developing non-invasive methods for detecting brain states might fall into this category.

Applied research is knowledge developed with a specific objective in mind, particularly the conversion of existing knowledge into products, processes and technologies. Applied research will generally have a mid-term time frame to the development of practical applications, eg. 2 to 5 years. A project aiming to create a prototype system that detects player-controllable brain waves and feeds them into a game engine as an interface device might fall into this category (e.g. http://www.heroicsalmonleap.net/mle/mindbalance/index.html).

Experimental development is work undertaken for the purpose of achieving technological advancement for the purpose of creating new, or improving existing, materials, devices, products or processes, including incremental improvements to these (http://www.ccra-adrc.gc.ca/taxcredit/sred/publications/recognizing-e.html). Experimental development projects are relatively short, typically being completed within one or two years or less. An example of this would be a project to develop a console controller interface to a skull cap containing electrodes as a product to integrate mind control with video game play.

Standard development is development by selection of standard solutions to well understood problems, requiring little to no innovation. This is the level not only of
traditional crafts, but also of routine industrial production. Standard commercial game development falls within this category.

Within this model of forms of research, long term, basic research asks more fundamental questions, involves more risk and has potentially very high payoff, in some cases generating results that totally transform the basic assumptions of a scientific field. At the other extreme, standard industrial production operates at a level of highly standardized practice, involves little to no innovation, and incurs minimum risk. Applying this model to game research shows that potentially long time scales may be involved (e.g. ten years or more) before more significant research results are generated and fed into industrial game design practice.

Scientific theories can be understood to include technological research, such as research within computing and communications technologies. In this case technological innovations may support new modes of game play. Examples here are numerous, including games based upon mixed and augmented reality technologies (eg. Szalavári et al, 1998, Björk et al, 2001, Piekarski and Thomas, 2002, Magerkuth et al, 2003, Magerkuth et al, 2004), and games based upon modified game play due to the development of artificial intelligence methods for more effective characterization, dramatic interaction and emergent story construction (e.g. Cavazza and Charles, 2005, Mateas and Stern, 2002).

Game Research in Relation to Autonomous Research Disciplines

In considering the relationship of research to game design, distinctions may be made between research specifically directed at understanding game form, research within autonomous disciplines that is directed at games as an application area, and research within autonomous disciplines that is not specifically concerned with games, as depicted on Figure 3.

Autonomous disciplines, such as the examples used in Figure 3 including human-computer interaction (HCI), artificial intelligence (AI), cultural studies, cognitive science, computer graphics, pedagogy and software engineering, have subcultures and processes that have no intrinsic dependency upon or interest in games. However, research within these disciplines may turn to games as an application area or object of study. In this case the specific methodologies and knowledge of those fields is applied to various questions arising from
gaming and game design and development. Core game research, however, is concerned with game form as its first priority. These different areas interact. Core game research may derive models and principles from applied research from other disciplines, while those applied disciplines benefit from the deeper analysis of game form undertaken by core game research. Hence the input from research into game design may be highly indirect, generating results firstly within autonomous discipline areas that are then fed into research applied to games, which then feeds into the central analysis and articulation of game form. Also, autonomous research does not need to feed into industrial game design and development via core game research, but may flow directly into industrial game development. In fact, all computer games are based upon research in this way, using research results that provided the foundations for the technologies and communications infrastructure with which computer games are implemented. At the time of writing, core game research is too young as an academic field to have had time to have much impact upon industrial game development, although this is likely to change as the field matures.

**General Theories Motivating Game Design**

*General theories* represent interpretation paradigms, or sets of basic assumptions about aspects of the world from which many other understandings may follow. An explanation that maps a phenomenon back to one or more of the basic assumptions or their implications within an interpretation paradigm constitutes an explanation within that paradigm. For example, identification of a player with a player character while playing a first-person shooter might be interpreted within a Freudian interpretation paradigm as the expression of unresolved Oedipal conflicts in which enemy monsters represent threatening aspects of the player’s (primal, symbolic understanding of their) father; then the Freudian-inspired designer might seek a game design that substitutes simplistic victory over the game boss with a more subtle process of identification with the father figure and transformation to a post-Oedipal psychodynamic motivation. Of course, the same phenomena can be explained by different interpretation paradigms in totally different ways, mapping them back to completely different foundational ideas. The interesting outcome may not be the theoretical justification in itself (which could be quite idiosyncratic), but the novel game concepts that result from it.

**Formal Reflexive Game Design**

Formal reflexive design focusses upon fundamental questions about the form of a creative medium; it is concerned with the production of artefacts that are about the medium within which they are produced, including conventions of production and interpretation for the medium in question. This approach has been a significant facet of modernist investigations of different media. Modernism has been a prominent cultural movement, particularly in the twentieth century, representing a radical change in the way different creative fields approach their work. This change has occurred within all established art forms and media, including painting and visual art, sculpture, literature, poetry, music, theatre, cinema, dance, and architecture. When cultural movements go through revolutions, genres tend to be attacked and mixed up, new genres are generated and old ones fade. These changes are often reactions against the prior cultural form, which typically has grown stale and repetitive. While the history of modernism is very complex, here it is possible to refer to a number of strong tendencies relevant to the game design meta-model:

- maximisation of self-consciousness and reflexivity in relation to a particular medium.
- questioning all aspects of the form and content of a medium.

- there is a movement away from representation, and away from or to disrupt conventional codes of representation.

- there is a strong focus upon pure form itself (e.g. line, colour, texture, material of the medium), frequently with a concern with the emotional, conscious and/or affective states induced by form (rather than by any denoted object). In the case of games this means a focus upon the essential nature of a game, and the relationships between the core game system and the media used to realise a game.

- a lot of modernist work has sought to answer the fundamental structuralist question: what is the medium? Since games have a tendency to be trans-medial (i.e. a particular game may be able to be realised using quite different media, e.g. as a board game, as a computer game, or as a game staged by people), the reflexive questions may be asked as to whether games can really be considered to be a medium, what may be gained or lost by considering them to be a medium, and if they are not a medium, then what are they?

Modernist work that disrupts conventions and expectations functions to make those conventions and expectations, and their consequences as media functions, become explicit rather than implicit. In a sense this amounts to the deliberate production by modernist artists of what might be seen as ‘misfit variables’ in Alexander’s (1970) terms in relation to the preceding media culture and how it expects art (or a medium) to function. Just as design misfits make design features visible, disrupted expectations make media form and function visible. Modernist works therefore function as explicit statements of abstracted media form and affect.

This paper will not dwell in any detail upon the vast and complex field of modernism. However, formal reflexive ideas of a kind that have been strongly demonstrated within modernism are here regarded as informing a large-scale cultural project of maximizing self-consciousness within various media. One key issue here, however, is that, as Small (1994) points out in the case of avant garde cinema, the high levels of self-consciousness and reflexivity involved in much formally reflexive practice do not rely upon textual or verbal representations. Rather, a great deal of work is self-consciously articulated within the tradition of its medium, in a form referred to by Small (1994) as direct theory. Writing may surround, refer to, critique and analyse works in other (than literary) media, but those ‘other’ media also have an autonomous discourse. This is the whole point of reflexive design, to create work that reflects upon its own form.

These considerations apply within all media. It may also be observed that formal reflexive or programs within a medium tend to ‘burn out’ or become exhausted after a period of intensive investigation. Avant garde artworks thereby function to map out a space of design possibilities from which ongoing work may draw without in itself being avant garde. In other words, avant gardes define a self-conscious design space in terms of which ongoing design may locate and define itself. Further innovations within these (‘modernistically’) exhausted media may proceed via postmodern strategies, often involving hybrid media forms, reiteration of past styles and forms, new combinations of formal elements, and self-conscious production of pre-modern or naïve forms in the form of self-conscious kitsch. This tends to occur together with a devaluation of the academised values of modernism and formal reflexiveness (which may be regarded as being ‘too sterile’), and the distinctions between ‘high’ culture,
popular culture and commercial culture break down. Meanwhile, if new media are developed, the modernist impulse becomes relevant again in application to those media, to push their limits and expose their form, meaning and functions.

Applying the formal reflexive perspective to game design asks fundamental questions about the nature of games and play, leading to experiments intended to stress our understanding of and assumptions about games and play. Examples of games manifesting this perspective include the genres of alternate reality games (see http://www.argn.com/) and larps played in games spaces where people may be interacting with gamers in a game but without any consciousness that they are part of the game. These examples raise questions about whether unwitting participants are players or not, and even of whether the game is a game or not, when it has extra-game consequences for (possibly unknowing) participants.

Formally reflexive game design constitutes a kind of avant garde game design practice having philosophical and operational similarities to other avant garde practices in the history of the arts. This does not mean that formalist work exhausts the possibilities of dealing with games from a contemporary artistic perspective. For example, artistic projects concerned with games may also be driven by theoretical considerations, or focus upon various rhetorical possibilities of game form. However, it is formally reflexive game design concepts that have the greatest self-consciousness about the fundamental nature of games and play.

An Integrated Meta-model

The design approaches described above represent an increasing level of explicitness and self-consciousness about game design, leading to the integrated design meta-model illustrated in Figure 4. The triangle form is used to suggest the metaphor of a pyramid, with higher levels being at least conceptually built upon lower levels, and involving a hierarchy of increasing abstraction and conceptual essentialism.

Moving from the base to the apex of the pyramid shown on Figure 4 represents the following tendencies:

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as already emphasized in this paper, an increase from implicit, unselfconscious design to more and more explicit and self-conscious design.

- a movement from a focus on the small scale details of a design to higher level abstract properties of a design.

- a movement of awareness from an intuitive understanding of form based upon an (extensional) understanding of very many examples to a more reflective (i.e. intensional, explicit and conceptual) approach to design and understanding of design features, based upon the extraction of a comparatively smaller number of generalizations from a large number of examples.

- a development away from design knowledge as peripheral background knowledge towards design knowledge as focused foreground knowledge.

- a shift of concern from the representational functions of a design toward basic game form. The representational functions of a design concern the (fictional) world of a game, typically following from a fictional genre (science fiction, fantasy, etc.). Basic game form concerns game mechanics and modes of interaction. The details of a represented game world can be modified extensively with no change to the underlying basic form, and vice versa.

- a decreasing stability of function of the design and increasing role of design per se. For example, modes of game play may be based upon well established models (e.g. ‘a role-playing game’, RPG, or ‘a first-person shooter’, FPS) at the bottom of the pyramid, while at higher levels completely new gameplay modes having unknown value for and effects upon players may be introduced. Commercialisation of unstable design forms may require consolidation of their functions into specific variants that can be communicated to markets and associated with market preferences.

The pyramid from the base to the apex also represents an increasing scope of novelty and innovation. At the implicit and cookbook levels novelty tends to be limited to representational content and small-scale details of formal design. Representational innovation refers to the development of new and novel types and instances of game stories, scenarios, characters and game objects, especially as conveyed by graphics and sound design. Small scale details in the game form itself might include elements such as parameter ranges for the features of game characters (e.g. attribute statistics, like strength, intelligence and dexterity), inventory items (values, damage points), etc.. At the level of design patterns, novelty may be achieved by new combinations of patterns being realized together within a specific game. At the level of theoretically motivated design, theoretical motivations may lead to, facilitate or require novel game mechanics, or mechanics designed to frustrate player expectations in order to make a specific point or to serve particular rhetorical aims. At the formal reflexive design level novelty may occur in the most fundamental aspects of a game design, leading to totally new kinds of games and play experiences, or even to questioning and redefinition of the players’ understanding of the very nature of a game.

Results of Applying the Design Meta-model

The design meta-model presented here has been applied in a game design education context. The model was initially devised to address the concerns listed in the introduction, and
particularly with a view to structuring design activities aimed at achieving higher than usual levels of innovation. ‘Higher than usual’ here refers to a history of design workshops within undergraduate game development programs and other professional and semi-professional design workshop contexts.

Statistical empirical testing of this kind of meta-model is impractical in the short term, the best global measure of its usefulness being the degree to which it may be referred to and/or used over time by professional game designers or game design educators. In terms of our immediate experiences in applying the model within undergraduate game design education programs, the following anecdotal evaluation information is offered:

- the meta-model has been used as the foundation for an advanced game design course in which students study the various levels of the proposed hierarchy. Within the course, games are brainstormed and developed to a playable stage and evaluated in a sequence corresponding to a movement up through the hierarchy, beginning in this course with the design patterns and taxonomies level, moving through theory-driven designs and ending with formally reflexive game design.

- the meta-model appears to be understandable to students (although not all levels are initially obvious). Students in the third year of a game development education program expressed the view that they really would have benefited from having this framework presented to them much earlier in their studies, since it provides a framework and language for talking about game design that they had lacked and would have greatly benefited from.

- the higher levels of the design pyramid represent areas that could be developed in endless ongoing detail. The framework therefore appears to represent a very convenient conceptual model for integrating ongoing research and development activities in game design, game aesthetics and related fields. Within the environment of the authors, the framework is very appealing as a high level map clearly interrelating the content of undergraduate game education programs and higher-level game research activities.

- the design workshops at the game pattern, theory-driven and modernist levels have resulted in examples of games having relatively high levels of interest and novelty compared with the typical results from game concept workshops in our experience. One simple example is the formally reflexive computer game Sumo, designed by Kajfa Tam. Sumo is a two-player game in which each player must place their fingers on specific keys on the keyboard. They must then try to use their respective hands to push their opponent’s hand so that at least one finger is pushed off its assigned key, without stopping pushing down on their own assigned keys. The first person to take a finger off a key is the loser. Sumo is a very simple game that nevertheless completely violates our normal expectations about computer game play and interaction.

- in many cases the initial reaction of students to the design assignments based upon the meta-model has been trepidation if not outright fear of entering design spaces having few if any exemplified precedents. Despite this, most of the resulting designs are successful in achieving fresh results and often highly entertaining game play.

The meta-model has also been very useful in clarifying our own thinking about design processes and methods, their interrelationships and the role of different kinds of research.
Conclusion

The game design meta-model presented in this paper is a principled heuristic framework interrelating a variety of design approaches, including implicit design (by copy), cookbook design methods, taxonomy and ontology-based game design, theory-driven design and formal reflexive design. The theory-driven level inspires new game and play concepts based upon technical, scientific and theoretical innovations, while the formal reflexive level represents the application of contemporary artistic perspectives to games. The meta-model provides a clear account of the nature and place of research both for motivating design decisions and for game design innovation, and provides a foundation that can be used for game education curriculum development integrated with higher-level research. We do not claim that the model is absolute; for instance, the boundaries between levels could be drawn differently; they represent tendencies rather than precisely definable distinctions. However, our experience indicates that the meta-model is effective in opening up new ways of thinking about, talking about and practicing game design, leading to fresh and innovative gameplay concepts.

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