

A Methodology for Digital Game Design Research

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Abstract

This paper outlines a research methodology for investigating the process of digital game design. This methodology has been successfully developed and applied during a doctoral inquiry investigating the design of games and simulations to promote conceptual learning in physics. A key challenge of that inquiry was to both outline and legitimate the design process as one of research. This paper follows the essential path taken in responding to this challenge: (i) detailing the nature of design; (ii) outlining how design can become research; (iii) detailing a methodological framework, including evaluation criteria; (iv) synthesizing the methodology into one in which design and research are entwined and inseparable; and (v) outlining further implications of the methodology.

Genesis!

Before detailing a methodology for digital game design research, I believe it is important to contextualize its genesis. During the early to mid 1990s while employed as an interactive television program designer in the United States, I became strongly interested in the potential of new media for learning science. This eventually led me to pursue a doctoral degree in science education (Stapleton, 2003), where I came to examine the design of a simple game prototype to promote conceptual learning in physics. More specifically, I wanted to investigate the design of games and simulations to promote students' conceptual understanding of Einstein's (1961) theory of special relativity, a scientific theory with its origin in creative visualizations and thought experiments (Miller, 1984, 2000). I understood my inquiry not simply as an academic pursuit, but rather, I felt that by undertaking the project, I would gain invaluable insight into the processes of learning, and into how to better design media to promote learning, thereby informing my practice. Further, at a more personal level, the inquiry would help to bind, what had been up to then, my (seemingly) disparate academic background in physics, with my professional practice in media.

Upon entering the inquiry, I had adopted a research approach that utilized the 'scientific method', due to a combination of my academic background in physics, and the traditional methods of design inquiry within science education which typically separated research from design (e.g., see Cobb (1998)). Adopting this approach led to a 'cause-effect' mentality with the inquiry having two separate phases; a design phase, and a research phase. During the first phase I would be engaged in designing the game prototype, understood as the 'cause', and during the second I would implement and observe students playing it within a university classroom, understood as the 'effect'.

However, this *design-then-research* approach quickly became problematic, as I came to recognize the game design process as a powerful context for learning. By gaining the views of others, playing with prototypes, and reflecting on these experiences during the design process, I gained new insights not only into the design of the game, but also into the nature of learning and inquiry. Consequently, I came to recognize that while designing, I was actively engaged in a research process, however this type of research could not be considered the same as 'scientific' research, and therefore, could not be legitimized as such under my current methodological framework. Accordingly, a critical aspect of my inquiry became the detailing and legitimation of a research methodology for the process of game design. This paper follows the emergence of this methodology.

Digital Game Design

It appears that digital game design is “a mysterious process” (Falstein, 2003, p. 3) and “a broad concept [with...] as many definitions of it...as there are designers” (Kreimeier, 2000, p. 1). However, developing a methodology appropriate for game design would seem to necessitate investigation into both game design and design more broadly.

Critical in my analysis of game design is the notion that “[a]lthough we label it with a noun, design is not a *thing* [...] it is] about the *activity* of *designing*” (Winograd, Bennett, De Young, & Hartfield, 1996, p. xx). Accordingly, in developing a method for game design research, I am seeking means for investigating and ‘demystifying’ the game design *process*. Such investigation, however, is non-trivial as “[d]esign is a complex and multifaceted process requiring the understanding and implementation of a range of skills and knowledge domains” (Mishra, Zhao, & Tan, 1999, p. 220). Consequently, exploring the many known facets of the game design process can facilitate the development of an appropriate methodology.

Mishra, Zao and Tan (1999) present twelve themes common to the process of software design¹ (see Table 1) which are applicable to digital game design. Although listed separately, these themes are not understood as mutually exclusive, but as rather interacting elaborately, consistent with design’s complex nature. Outlining these themes can provide a theoretical framework for what I mean by ‘*design process*’, thereby assisting the development of appropriate methods of inquiry.

1	Design is purposeful, intentional and conscious
2	Design keeps human concerns at the centre
3	Design is knowledge-intensive
4	Design is historical and path-dependent
5	Design is selective
6	Design is aesthetic
7	Design is communication
8	Design is a social activity
9	Design is creative
10	Design is emotional
11	Design is an ongoing conversation
12	Design requires closure

Table 1 Common themes of the design process (Adapted from Mishra et al. (1999))

Theme one views design as being “concerned with the invention of artifactual forms—an activity that aims to satisfy human goals and aspirations” (Mishra et al., 1999, p. 224). Further, no single game design method exists as “[a] single right way of developing software was a fashionable delusion widely believed in the 1990s” Kenny in Fischer (2003, p. 7). Suggesting a comprehensive approach to digital game design would neglect the dynamic nature of the design context which is “always in flux” (Fischer, 2003, p. 10) varying between projects and studios. Contributing to game design’s idiosyncratic nature, is that idea that design is as much “identifying problems” (Lawson, 1997, p. 125), or “problem *setting*” (Schön, 1983, p. 40), as it is about “problem *solving*” (p. 39). Solving design problems is intrinsically subjective as “not

¹ The themes outlined by Mishra et al. (1999) are founded on “previous theoretical and empirical work on the design process” (p.224) (see Winograd (1986), Winograd (1996), Schön (1983) and Dasgupta (1996)).

only are designers likely to devise different solutions but they also perceive problems differently [thus] there are an inexhaustible number of different solutions [to design problems]" (Lawson, 1997, p. 122). The role of the game designer is to "find solutions that fit" (Falstein, 2003, p. 21).

Game designer Noah Falstein's following remark offers insight into solving game design problems:

[game] design is a planning process, where one proceeds from murk to clarity, successively improving and refining a concept. But the process is not a mechanical or deterministic one, and it requires knowledge not only of games, but also a keen appreciation of human nature and a sense of what is fun. (Falstein, 2002)

Accordingly solving game design problems requires both *planning* and *iterative refinement*, and thus can be understood as a mix of two broadly defined, diametrically opposed, styles; *planner* and *bricoleur* (Turkle & Papert, 1991). As planners, game designers use detailed documentation to define the requirements at the start of the project. Design is achieved "top-down" with problem solving being viewed as a process of "breaking down the [design] problem into more meaningful subproblems" (Kafai, 1995, p. 70). Alternatively, bricoleurs adopt an iterative process whereby a prototype is playtested then analysed, thereby informing the design for the next iteration. Only the basics [are] defined at [the] start" (Fischer, 2003, p. 5) and the design emerges "bottom-up". Bricoleurs understand problem solving as "a conversation with the situation, in which the final solution emerges at the end" (Kafai, 1995, p. 70). Rather than suggest a single 'correct' approach, I understand these styles as being connected at both ends of a single spectrum where "[a] combination of both planning and bricolage seems to be a more accurate way of describing the game design process" (Kafai, 1995, p. 81).

Theme two involves keeping human concerns at the centre. User-centred design is "a philosophy based on the needs and interests of the user, with an emphasis on making products useable and understandable [...whereby] (1) the user can figure out what to do, and (2) the user can tell what is going on" (Norman, 1998, p. 188). Particularly important is the idea that "[t]he human factors aspect of any software is usually seen in its interface [...as] the conceptual structure of the domain and its mapping onto the design and architecture of the [software...] is revealed to the user through the interface" (Mishra et al., 1999, pp. 225-226). Accordingly, a key concept of user-centred design is *representation*, as designers can only communicate to users through the artifact itself; a representation of what the designer has in mind.

Theme three introduces design as being knowledge intensive. Falstein's (2002) earlier comment illustrates how game design requires knowledge from a variety of different fields such as psychology and technology, plus those relevant to the particular focus of the game such as history, nutrition, science fiction and so on. Further, game design is a "[p]artially a conscious activity [...and] partially intuitive" (Falstein, 2003, p. 3) in which both formal and informal, or tacit, knowledge are both brought to, and learned during the design process. Accordingly, "[t]he design process is also a learning process" (Mishra et al., 1999, p. 226).

Theme four suggests "[h]istory is present in one way or another in acts of design [...and] artifacts [...] are constrained by their evolutionary pasts" (Mishra et al., 1999, p. 227). The design process has a distinctly episodic structure" (Rowe, 1987, p. 34) and an "opportunistic nature" (whereby "small events, whether random or planned, [can have] large consequences" (p.227).

Theme five, selectivity, identifies design's subjective nature with "[t]he process of selection (and the corresponding process of rejection) [being...] as often unconscious as conscious" (Mishra et al., 1999, p. 229). Further, as design problems have no optimal solutions, these "selections are often the result of compromises" (p. 229), and ones which can lead to both good design, and design failures.

The affective aspect of design, theme six, is particularly pertinent to game design as an entertainment medium which provides "*enjoyment* and *pleasure*" (Prensky, 2001, p. 108) as "[m]aking games "fun" is [the] only objective" (Miyamoto in Saltzman (1999, p.85)). Typically, research into human-computer

interaction focuses cognition and often neglects the “aesthetic, affective and emotional” (Mishra et al., 1999, p. 229) aspects of design, however recent “[a]dvances in our understanding of emotion and affect have implications for the science of design” (Norman, 2002, p. 1).

Theme seven, design as communication, introduces the idea that “[d]esigned artifacts communicate content, often on multiple levels [...as a]nybody using a computer enters into a communicative relationship with the machine and software” (Mishra et al., 1999, p. 230). In particular “[t]he user interface can be seen as the location of both communicative and metacommunicative acts [...] in which multiple meanings are communicated including the functional, cognitive, connotative, and aesthetic” (p. 231).

The social nature of design is explored in theme eight, since “design cannot be practiced in a social vacuum” (Lawson, 1997, p.264). By viewing design as the activity of an individual designer “we can fall into the error of assuming [...] a single designer can grasp all that is needed to design [...] complex computer programs [...] and] that the overall quality of a design is primarily the result of the qualities and activities of the creative individual” (Mishra et al., 1999, pp. 231-232). Rather, design is always achieved within a broader social context which is “both facilitated and constrained by other people” (p. 231).

Creativity, theme nine, shows how “along with [the] need for design thinking goes the need for creative thinking” (de Bono, 1996, p. 66). Faced with new problems and constraints, designers generate “new ideas, new strategies, and new solutions” (Mishra et al., 1999, p. 232). Further, this creative or “lateral thinking” (de Bono, 1996, p. 34), is achieved by having designers “play around with concepts” (p. 34) and consequently the concept of ‘play’ is intrinsic to the game design process².

Theme ten addresses the emotional nature of design as “[t]he birth of a design is a laborious process of negotiation between designer and design [where...] the designer often becomes emotionally attached to the artifact” (Mishra et al., 1999, p. 233). Being an emotional process, the attachment a designer feels toward the artifact “can both motivate and enhance the growth of a design or hamper it” (p. 233). Accordingly, while completing any artifact “would be impossible without an emotional commitment to the project” (p. 233) the designer must remain able to step back from the project in order to “see its flaws and weaknesses” (p. 233).

Theme eleven is understanding design as “a conversation with materials [which] goes to the very heart of the design process” (Mishra et al., 1999, p. 233). Digital game design can therefore be understood as an “ongoing dialogue between the designers, the design and the testing audience” (Zimmerman, 2003, p. 1) that manifests itself as a “rapid cycle of building prototypes, testing them, scrutinizing them, and redesigning them” (Schrage, 1996, p. 192). In a quality design process, this conversation is “reflective” (Schön, 1983, p. 79) occurring both *during* and *after* design activity³. Further, often this conversation “happens within and across multiple levels—between theory and practice, between constraints and trade-offs, between the designer and the materials and between the designer and the user” (Mishra et al., 1999, pp. 234).

The final theme, design requires closure, suggests that while design is an ongoing conversation, eventually the designer must “[tie] all the threads and pieces of the design together to create an overall

² During my inquiry, I related this idea of conceptual play with the learning process of “conceptual change” (Hewson, 1982; Hewson, Beeth, & Thorley, 1998; Hewson & Hewson, 1992; Posner, Strike, Hewson, & Gertzog, 1979, 1982) thereby reiterating the notion of the design process as a learning process, and also illustrating the importance of play in thinking and learning as “[p]lay, it appears, is the very essence of thought” (Bohm & Peat, 1987, p. 48).

³ The idea of reflecting during design activity, “reflection-in-action...is closely tied to the experience of surprise” (Schön & Bennett, 1996, p. 173) in which the designer thinks about what they are doing while still doing it. Other situations may cause the designer to “stop and think” (p. 173), a process of “reflection-on-action” (p. 173), while in others designers may reflect on their design strategies and practices that have emerged during their design experience; “reflection-on-practice” (p. 175).

sense of unity and coherence [...as w]ithout this closure, the final product is incomplete and causes the design to be unstable, unsettling and useless” (Mishra et al., 1999, p. 235).

By outlining these twelve themes, I hope to illustrate the complex and multifaceted nature of the design process with the aim of developing a methodology appropriate for inquiring into these themes.

Design as Research

With design understood as a fundamentally mysterious, complex and dynamic activity, a key insight during my doctoral research was understanding the design process as a research process the aim of which is to “demystify the process [of design]” (Swann, 1999, p. 7). Early approaches to design research during the “1950-60s [...] promoted a ‘scientific method’ [of...] design problem solving [...] and f]or more than twenty years the belief that research in design [...] should be founded in scientific objectivity and positivist formulas went almost unquestioned” (p. 2). However, the emergence alternative research approaches from the social sciences saw a number of viable means of inquiry which had “more affinity with design processes than the science/engineering model” (p. 3). Of particular significance were the qualitative, interpretive approaches to research as “[d]esign research is not as quantifiable as science and engineering, and *interpretive* research is a form of qualitative research which is better suited to the behavior and sensitivities of human beings, relying more often on insight for the interpretation of human actions” (p. 3).

A research methodology for game design needs to account for the natural context of the design activity, including its multidisciplinary nature, and also be consistent with the notion of design as an ongoing conversation. Qualitative researchers are “committed to the naturalistic perspective and to the interpretive understanding of human experience” (Denzin & Lincoln, 2000, p. 7) through the application of a variety of methods and approaches which “[crosscut] the humanities and the social and physical sciences [...] and] can be combined in the same project” (p. 7). Adopting a qualitative approach to research provides a means of inquiry for investigating the planner’s positivistic, cause-effect and top-down approach, as well as the bricoleur’s bottom-up, conversational, emergent, approach of solving design problems.

At its most fundamental, the design process follows a “decision sequence of analysis, synthesis and evaluation” (Lawson, 1997, p. 35). Although presented linearly, the process is far more fluid with the sequence “problem—analysis—synthesis—evaluation” being cyclical. Within this iterative map of the design process, it is the key moment of *synthesis*, “when all the problem parts are brought together in a holistic solution” (Swann, 1999, p. 4), which sets it apart from scientific research per se. In short, “[design is] concerned with “synthesis”, while science is concerned with “analysis”” (Simon, 1998, p. 4). Design, therefore, is a process which aims to generate *solutions*. In contrast, research, in its scientific sense, is directed through *analysis* and accordingly focuses on *problems*. The solution-focused strategy of design relies on intuition, a “right brain way of processing [...] which] handles [...] non-verbal, visual/spatial holistic thinking” (Swann, 1999, p. 5), whereas scientific research⁴ relies on “left brain [...] deductive and sequential reasoning” (p. 5). Design therefore, is a problem-solving *performance*, one of ‘knowing-in-action’ (Schön, 1983, p. 50) where “the know-how is *in* the action” (p. 50). Emergent from this notion of ‘knowing-in-action’ is a view that “[t]he design process *is* a research process” (Swann, 1999, p. 5):

⁴ I am not suggesting here that that science is devoid of right brain thinking, but rather that creative insights, tacit knowledge and the like, remain implicit, beyond the domain of empirical science and cannot, therefore, be legitimized as (scientific) research (see also Guba and Lincoln (1989)).

[t]he action of designing is the same moment of synthesis that occurs in all forms of research (serendipity, as many social science researchers call it) and in design this synthesis may be expressed as visual spatial knowledge in action. (Swann, 1999, p. 5).

It is this concept of *action* that helps fuse the process of design with qualitative research—namely the family of methodological approaches termed *action research*. Action research involves the “simultaneous achievement of action (that is, change) and research (that is, understanding)” (Dick, 2000, p. 1), and is “a practical research methodology [...] requiring three conditions to be met” (Swann, 1999, p. 5):

First, its subject matter is normally situated in a social practice that needs to be changed; second, it is a participatory activity where the researchers work in equitable collaboration; and third, the project proceeds through a spiral of cycles of planning, acting, observing and reflecting in a systematic and documented study. Carr in Swann (1999, p. 5)

The cyclical nature within action research of *plan–act–observe–reflect* bears deep resemblance with design’s *problem–analysis–synthesis–evaluation*. Additionally, both design and action research can be regarded as processes for changing social reality as designers “[devise] courses of action aimed at changing existing situations into preferred ones” (Simon, 1998, p. 111). Such is the connection between action research and design activity that “it would only require a few words for theoretical frameworks of action research to make it applicable to design” (Swann, 1999, p. 6).

Action research, a research methodology “intended to have both action outcomes and research outcomes [...] tends to be [...] cyclic, participative, qualitative and reflective” (Dick, 2000, pp. 3-4). In order to achieve action, action research “has to be able to respond to the emerging needs of the situation” (p. 2). Action research is also emergent, with the early cycles shaping the future direction of the investigation and the latter cycles used to evaluate interpretations developed during the earlier ones. Being qualitative, action research uses natural language and allows for both qualitative and quantitative approaches to be employed. Finally, action research requires critical reflection in which “[t]he researcher and others first recollect and critique what has already happened [...] and t]he increased understanding which emerges from [...] critical reflection [...] helps design] the later steps” (pp. 2-3).

While both action research and design can be considered processes for changing (social) reality, applying “the second and third conditions of action research to the design field (i.e., emancipatory participation and systematic reflection) [is...] more challenging” (Swann, 1999, p. 6). However, by adopting these established principles from action research could enable design “[to] be enriched and fortified” (p. 6). Critical, then, in the development of an appropriate methodology for design is an appropriate resolution of the key challenges of emancipatory collaboration and systematic reflection.

The former issue suggests “the users of design should be genuine *collaborators*” (p. 7) and this is equally applicable to individual designers and design teams. The latter issue “demands public accountability and visible self-evaluation [...] which] is assuming increasing importance for current design practice” (p. 7). Although design is a reflective activity, the need for “‘systematic and documented study’ is a failing which [...] has perpetuated for many years [...] as c]ase studies [...] are almost non-existent in design” (p. 7). Adopting emancipatory collaboration and systematic reflection from action research will help enable design to move better recognized as a research process in which the following strategies are central:

▪ data gathering by participants
▪ participation and power-sharing in decision-making
▪ collaboration as a critical community
▪ self-reflection, self-evaluation and self-management
▪ learning progressively by doing and making (mistakes) in a 'self-reflective cycle'
▪ reflection and communication to the broader community

Table 2 Key features of design research (Swann, 1999, p. 8).

Constructivist Inquiry

Even though I understood the design process as research process, finding an *appropriate* action research methodology that could investigate the various design themes and also resolve the key challenges of emancipatory collaboration and systematic reflection remained. The methodology needed to be consistent with a view of learning reflective of design activity that could take into account multifaceted pre-existing knowledge and experience, tacit knowledge the designer brings to the design task along with the subjective, reflective and conversational nature of design. During my inquiry I understood this type of learning as being consistent with *constructivism*, a learning theory which formed the basis of my methodological approach.

Constructivism, with its roots in “genetic epistemology” (Piaget, 1970), “provides a plausible, functional framework for understanding and interpreting experiences of learning” (Treagust, Duit, & Fraser, 1996, pp. 3-4) in which learners actively build, or ‘construct’, knowledge based on their prior knowledge and experiences of the world. Learning is therefore understood as an active process. Further, an implication of adopting this view is that the external world, or ‘reality’, is understood as a human construction (Hardy & Taylor, 1997), and consequently while constructivist do not deny the existence of an external reality they maintain that it can only ever be known “in a personal and subjective way” (von Glasersfeld, 1990, p. 3). I came to transfer the “cognitive position” (Noddings, 1990, p. 7) of constructivism, reflective of my own understanding of learning, into the realm of research.

Fourth Generation Evaluation (Guba & Lincoln, 1989) is a qualitative, action research methodology, founded on constructivist principles which aims to move beyond the conventional positivist paradigm of science, to include a variety of other factors; human, social, cultural, political and so on. Although it can be regarded as an ‘off-the-shelf’ methodology, choosing fourth generation evaluation was not simply a (blind) top-down process of adopting a constructivist methodology and then (forcefully) applying it to design contexts. Rather the selection, modification, adoption and (eventual) synthesis of constructivist inquiry, was founded and shaped by the contexts and events of my (media and game design) practice⁵.

Fourth generation evaluation is a process “organized by the claims, concerns, and issues of stakeholding audiences, and [...] utilizes the methodology of the constructivist paradigm” (Guba & Lincoln, 1989, p. 71). Being a qualitative research methodology, significant differences exist between the ontology⁶ (theory

⁵ Also, other research methodologies were selected and shaped by considering design contexts and experiences.

⁶ *Ontology* is the branch of philosophy known as *metaphysics* “that is concerned with issues of existence or being as such” (Guba & Lincoln, 1989, p. 83). The ontological question asks “What is there that can be known?” (p.83), or equivalently “What is the nature of reality?” (p. 83). *Metaphysics*, “[o]riginally a title for those books of Aristotle that came after *Physics* [...] is] any enquiry that raises questions about reality that lie beyond or behind those capable being tackled by the methods of science” (Blackburn, 1996).

of existence), epistemology⁷ (theory of knowledge) and methodology⁸ (theory of method) of constructivist inquiry, and the conventional (positivist) methodology of scientific inquiry. Methodologically, the conventional paradigm adopts “an interventionist methodology [that] strips context of its contaminating (confounding) influences (variables) so that the inquiry can converge on truth” (Guba & Lincoln, 1989, p. 84). In contrast, the constructivist paradigm adopts “a hermeneutic [or interpretive] methodology [that] involves a continuing dialectic of iteration, analysis, critique, reiteration, reanalysis [...] leading to the emergence of a joint construction of a case”(p. 84). The joint construction is created through the dialectic between the various participants of the inquiry within the research context including the inquirer(s).

The essential task of a constructivist investigator is to explore the *constructions*, or “created realities” (Guba & Lincoln, 1989, p. 143), of the various participants within the research context, with the aim of joining them (synthesis), with other information (data) that bear significance on the issues involved in the investigation. Dialogue is essential to constructivist investigations as the comparison and contrasting of respondents views is a key process of the “hermeneutic dialectic” (Guba & Lincoln, 1989, p. 149) central to constructivist inquiry. The process is “hermeneutic because it is interpretive in character, and dialectic because it represents a comparison and contrast of divergent views with a view to achieving a higher-level synthesis of them all, in the Hegelian sense” (Guba & Lincoln, 1989, p. 149). The ultimate aim of this process is to form connections between these various views so that a consensus can be reached, or, if a consensus cannot be reached, key areas of difference for future negotiation can be established. Successful constructivist inquiry, therefore, “aims to change constructions, or realities, is contextualised within a naturalistic setting, uses an action based cyclical process of a hermeneutic dialectic out of which a synthesis view emerges, and where all participants are empowered and educated as part of the process” (Stapleton, 2003, p. 136). Further, unlike the methodology of conventional scientific inquiry, tacit knowledge such as “intuitions”, “insights”, “creative imaginings” and “thought experiments” all form part of constructivist inquiry.

Consequently, when undertaking successful constructivist inquiry, the researcher must adopt: (i) a naturalistic context, (ii) the inclusion of tacit knowledge, (iii) the human as the instrument of inquiry and (iv) the use of qualitative methods (Guba & Lincoln, 1989, pp. 174-176). Once these entry conditions have been met, the inquiry proceeds by selecting appropriate respondents to enter the hermeneutic dialectic circle via “purposive sampling” (p. 178); namely “selecting a sample from which one can learn the most” (Merriam, 1988, p. 48). Within the hermeneutic dialectic exists a “continuous interplay of data collection and analysis that occurs as the inquiry proceeds” (Guba & Lincoln, 1989, p. 178) in which various views are compared and contrasted. Further, as the inquiry proceeds participants are asked to comment and evaluate those constructions already developed out of which a “*joint* construction” (p. 179) emerges. An important attribute of this joint construction is that the findings are *grounded* in the constructions of all the respondents via the hermeneutic dialectic process. Accordingly, the joint construction “differs from the individual constructions originally offered by respondents, and [...] from] the construction entertained by the investigator at the beginning of the study” (p. 179). The last element of the constructivist inquiry process is that of “emergent design” (p. 179) whereby “[i]nitially [...] it is impossible to be very specific about anything [b]ut as the design proceeds, the constructivist seeks continuously to refine and extend the design—to help it unfold [...] until there is consensus” (pp. 179-180).

Unlike the conventional paradigm of positivistic science which focuses on the “criterion of *correspondence* (between findings and reality)” (italics added)(p. 180), the constructivist focuses on

⁷ *Epistemology* is “the branch of philosophy that deals with the origin, nature and limits of human knowledge” (Guba & Lincoln, 1989, p. 83). The epistemological question asks “What is the relationship of the knower to the known (or knowable)?” (p. 83), or similarly “How can we be sure that we know what we know?” (p. 83).

⁸ *Methodology* “is a more practical branch of philosophy [...] that deals with methods systems, and rules for the conduct of inquiry” (Guba & Lincoln, 1989, p. 83). The methodological question asks “What are the ways of finding out knowledge?” (p. 83), or equally “How can we go about finding out things?” (p. 83).

consensus. Achieving consensus, rather than signalling the end of the inquiry, allows for future inquiry through the introduction of “new information or new levels of investigation” (p. 180). Further, if consensus cannot be reached, then the inquiry process can help identify those areas of difference “about which further negotiation” (p. 180) can take place.

The final outcome of the inquiry is a “case study report [...which provides] the *joint construction* that emerges as a result of the hermeneutic dialectic process [...through] thick description that not only clarifies the all-important context but that makes it possible for the reader to vicariously experience it” (p. 180). The case study report also includes the methodological approach so that it “possible to judge the extend to which *goodness criteria* have been met” (p. 181). Accordingly, a critical component of any constructivist inquiry is the identification of appropriate evaluation criteria to ensure judge its adequacy.

In judging the adequacy, namely goodness and quality, of any constructivist inquiry there exist three different approaches: (i) *trustworthiness or parallel criteria* ;(ii) *the nature of the hermeneutic process itself* and (iii) *authenticity* criteria (p. 233). The *parallel criteria* for judging the adequacy of constructivist inquiry “are intended to parallel the rigor criteria [internal validity, external validity, reliability, objectivity...] within the conventional paradigm” (pp. 233-234). Alternatively, the *hermeneutic dialectic process* can be understood as its own form of quality control. Data can be analysed instantly and fed back into the cycle “for comment, elaboration, correction, revision, expansion or whatever” (p. 244) by the individual respondents who just made them, and this process continues with the emerging joint construction which incorporates this data. Finally there exists the *authenticity criteria*, which “spring directly from constructivism’s own basic assumptions” (p. 245) without the need for the positivist claims for rigor.

Synthesis!

In developing a methodological approach for digital game design, and keeping the complex nature of design in mind, I came to synthesize the notion of ‘design as research’ with elements of ‘constructivist inquiry’. Crucial in this synthesis, was the modification and reinterpretation of constructivist inquiry within the context of design, understanding further associations between design and research, and resolving the key challenges of Swann (1999) of emancipatory participation and systematic reflection for design to become research.

I recognized, that the similarities between design and constructivist inquiry are the same as for all action research. Both design and constructivist inquiry require a naturalistic setting, seek the transformation of social reality, necessarily include both formal and tacit knowledge, accommodate different problem solving (top-down, bottom-up) and methodological (quantitative, qualitative) approaches, and can be achieved through an iterative process. Further, beyond these connections, constructivist inquiry can provide a framework to resolve the issues of emancipatory participation and systematic reflection.

Emancipatory participation requires designers to become genuine collaborators with others; both the design team and users. Within constructivist inquiry, collaboration within constructivist inquiry is evidenced through the dynamic of the hermeneutic dialectic where various respondents engage in dialogue from which a joint construction emerges. By understanding design activity as a conversation, I came to extend the methodology of constructivist inquiry beyond its original interpretation and into the context of design. Originally, the hermeneutic dialectic a ‘participant’ referred to a human respondent, however, understanding design as a conversation led me to conceptualize the materials themselves as being a ‘participant’ within the hermeneutic dialectic. As a result, I now allowed for a variety of ‘data types’—sketches, programming code, storyboards, game prototypes and so on—all to be included as part of the inquiry, supplementing human conversations typical of constructivist inquiry.

Further, understanding the materials as an active participant also required a reinterpretation of the hermeneutic dialectic process, the very key to constructivist inquiry. Originally, the hermeneutic dialectic process follows a (rigid) protocol of asking a (human) respondent to nominate another whose views differ from their own construction, thereby providing the contrasting positions necessary for a dialectic.

However, in shifting the context to design, I understood the hermeneutic dialectic as being more fluid and organic, with respondents (including the materials) engaging in a process of dialogue out of which differences emerge as a result of *my own interpretations* rather than requiring strict direction from a (human) participant. Consequently, I came to understand the hermeneutic dialectic as more of a freeform collaboration in which I could self-direct investigation toward many paths of inquiry.

In the context of design, I understood such collaboration as being central to prototype design since “to succeed in its purpose, a prototype cannot be seen as the property of the engineers, of the developers, or of the marketer [...] it has to be community property [...] thus t]he politics of prototypes play a large part in shaping their potential value” (Schrage, 1996, p. 201). Consequently, I related the collaborative process of prototype design with that of constructivist inquiry, as it provides a means for developing joint constructions within design contexts, manifesting partly within the design itself, as well as facilitating power-sharing between participants.

Turning to the issue of systematic reflection, I understood reflection as integral to the notion of design as a reflective conversation whereby designers become researchers through self-reflective cycles of examining their practice. Nevertheless, the need for design activity to embrace “systematic and documented study” (Swann, 1999, p. 7) remained. This was resolved though the very nature of constructivist inquiry itself in which a case study report offering a joint construction is the final deliverable. Consequently, within a design context, research would include the final designed artifact, together with the rich descriptions of the contexts and various conversations, events, objects and experiences which shaped the outcome detailed within the case study. Accordingly, embracing constructivist inquiry as a means for investigating game design can resolve the challenge of systematic reflection by delivering a case study that complements the final artifact.

Resolving the issues of systematic reflection and emancipatory participation by modifying constructivist inquiry for design contexts, addresses Swann’s (1999) final requirements for the creation of a design research methodology. Also, applying constructivist inquiry within design allows for the various evaluation criteria to be transferred into the design context, thereby providing a number of authenticity criteria for judging the quality of the inquiry within game design contexts.

Resolving these issues meant that the design process could be understood, and validated, as a research process. However it was not until I incorporated the notion of constructivist research having emergent design, and therefore the idea of research process as a design process, that I synthesized the methodology as a single whole. In effect, both research and design were entwined and inseparable. (Game) design *is* a research process and (constructivist) research *is* a design process. It was from this key insight of design being a research process, and (constructivist) research being a design process that I came to name the methodology *Research as Design-Design as Research* or RADDAR. Further, only after I understood RADDAR as a synthesized, unified methodology did I come to recognize the serendipitous nature of the connections between design and research.

For example, I later discovered a hermeneutic dialectic process within (architectural) design inquiry (Rowe, 1987) thereby strengthening my adoption of this process from constructivist inquiry, and also its application as a means inquiry into design activity via the application of RADDAR.

Further, understanding the design process as “distinctly episodic” (Rowe, 1987, p. 34) led me to associate the notion of reflective practice (Schön, 1983) evident within design, with the action research methodology of *critical incidents* (Tripp, 1993) traditionally understood within the context of teaching practice. The essence of critical incidents “begins with material practice and creates theories through involving [practitioners] in the process of theorizing [and...] is a ‘grounded theory’ approach [...] in which incidents from [...] practice are theorized”. (Tripp, 1993, p. 148). The striking similarity between critical incidents and reflective practice, in which the design process is understood as research, enabled me to transfer critical incidents from education and into the domain of design, thereby enabling designers to “reflect upon [their] practice to change it or view it differently” (Tripp, 1993, p. 12) ultimately promoting professional awareness. In addition, both critical incidents and reflective practice aim to revolve the (apparent) dichotomy between domains of practice and theory (or research) in which

“the researcher’s role is distinct from, and usually considered superior to, the role of the practitioner” (Schön, 1983, p. 26).

It had been this dichotomy, between research and practice, during my doctoral inquiry which led me to legitimize design practice as research, and ultimately synthesize the RADDAR methodology. Theory, the realm of researchers, and design, the realm of practitioners, were initially understood as being mutually exclusive. However, I later came to understand that “what is often perceived as a gap between the application of a theory and practice is often a gap between different theories, between the theory of researchers and the theory of [practitioners]” (Tripp, 1993, p. 147). I recognized how professional practice, including design, had predominantly been guided by the perspective of “Technical Rationality” (Schön, 1983, p. 21) which focuses on the process of “problem *solving*” (p. 39), and thereby adopts the (positivistic) approach of science and its focus on analysis. However, adopting this “Technical Rationalist” approach means that “problem *setting*” (p. 40) along with the various contexts and tacit knowledge the practitioner comes to utilize is ultimately ignored. It is critical, therefore, that research of professional practice must be ‘grounded’ in the contexts of practice, and include the various forms of knowledge, experiences, insights and so forth that form part of the problem setting process in addition to the analytical aspects of problem solving. Theories of game design research, therefore, must be derived, or *grounded*, from actively reflecting upon the various experiences and (critical) events designers experience during their practice. I recognized that, at its very core, RADDAR offered a dialectic between (constructivist) research and (game) design practice via a grounded, constructivist approach to inquiry requiring the inclusion of tacit knowledge, and critical reflection on various events, experiences and conversations during the (game) design process by way of a hermeneutic dialectic.

The final key process in fully developing my understanding of RADDAR was to represent the methodology visually. Naming the methodology RADDAR provided insight into the dynamic relationship between the core processes of design and research, and suggested a metaphor for its action and visualization. I recognized that like the term *radar*, which centres on the relationship between objects and events (positions in space and time) through a physical process of reflection, RADDAR provides a means for understanding the relationship (and collaboration) between objects (people, materials, artifacts) and (critical) events through a (dialectical) reflective process which aims to unmask the design-research process and move toward some form of agreement, consensus, or understanding (see Figure 1).

Represented visually, the circular arrows in Figure 1 represent the dynamics of conversation between ‘research’ and ‘design’ (large circles) whereby the differences between them are reflected upon and interpreted, and where the researcher/designer (reflectively/interpretively) situates h(im/er)self in the research-design process (i.e., hermeneutic dialectic circle). In addition, this process extends to the smaller circles (themes of inquiry), which are also “in dialogue” with research and design—representation, and other collaborators and participants—along with theory and practice through their own hermeneutic dialectic. Now, while only two themes of inquiry (small circles) are illustrated in Figure 1, RADDAR, as a qualitative research methodology, allows for a number of themes to be investigated by the inquirer through a variety of methods. Accordingly, RADDAR is understood as a dynamic methodology which can be shaped to the particular contexts and foci of specific inquirers rather than present itself as being rigid and fixed. Nevertheless, I soon recognized an apparent ‘contradiction’ inasmuch that both ‘research as design’ and ‘design as research’ needed to simultaneously co-exist in a unified, single methodology. In other words, I needed a means of having (emergent) design being a subset of research (research as design) while simultaneously having research as subset of design (design as research). I resolved this issue by extruding my two-dimensional representation into three-dimensions and adopting the metaphor of ‘perspective’. Taking the perspective of research means to look from research toward design (from left-to-right in Figure 1) in which design is now a subset of research. Using the same single RADDAR model, but now taking the perspective of design, identifies the research process as a subset of design. An equivalent simplified model for representing the dynamic entwining of research and design essential to RADDAR, is the ‘yin-yang’ relationship evidenced in the Chinese *T’ai-chi Tu* (Capra, 1991, p. 119)(see Figure 2).

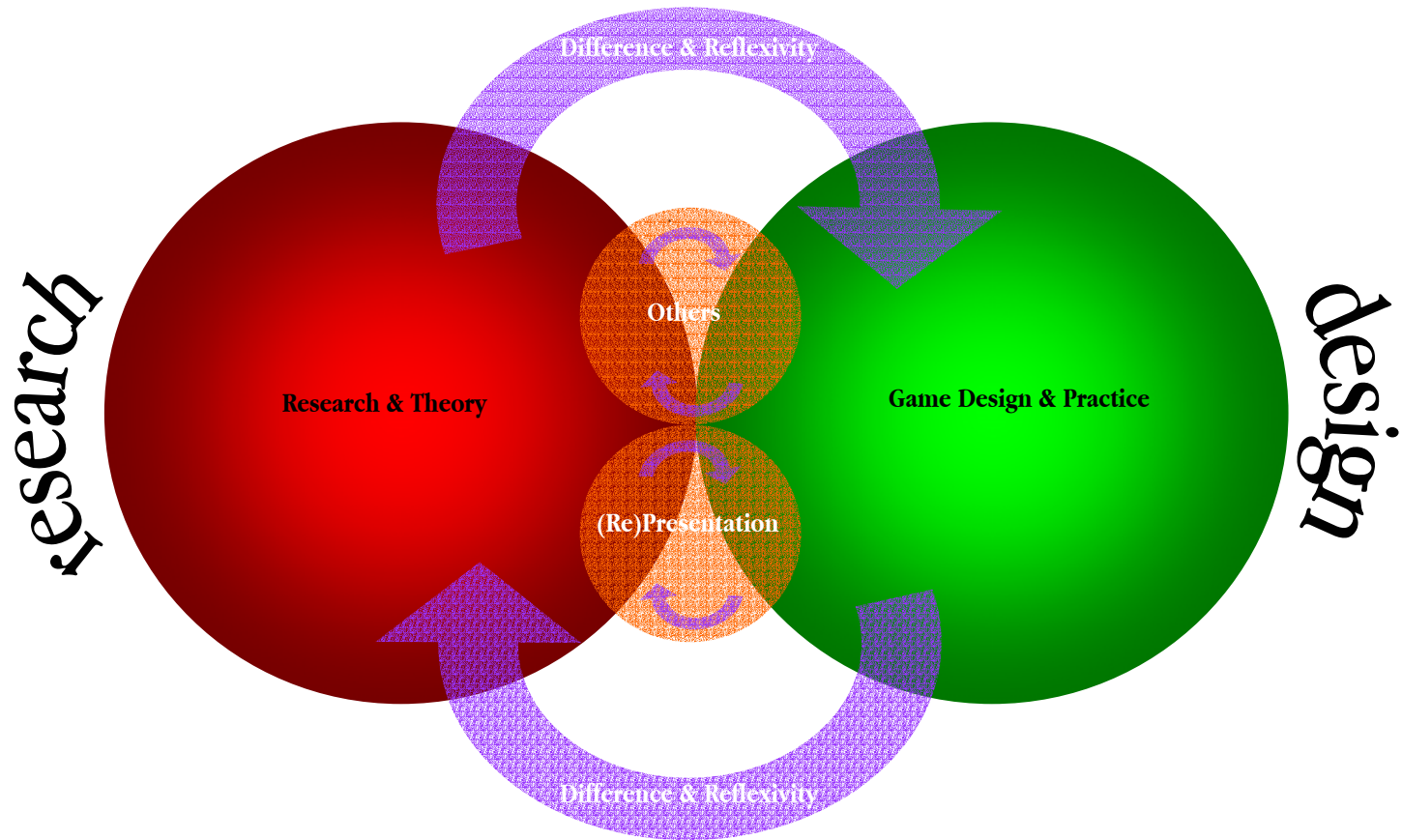


Figure 1 A Visualization of RADDAR

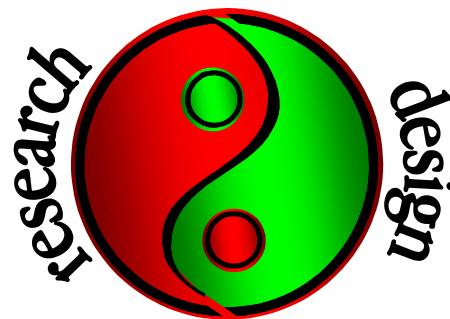


Figure 2 The essence of RADDAR

Implications of RADDAR

As an action research methodology, RADDAR provides means to investigate various aspects of design activity through its key dialectical relationship between design and research. In short, within RADDAR the (game) design process is understood as a research process, and (constructivist) research as a design process, and the two cannot be meaningfully separated. RADDAR can also be shaped by the particular needs of the inquirer by including a number of key themes for inquiry (see the small circles in Figure 1) and different methodologies. Further, like other forms of action research, the focus can shift more toward action (and design outcome) or research (and case study) depending upon the context and goals of the action and inquiry. In either case, a key requirement in adopting RADDAR is that the inquiry is undertaken within the naturalistic setting of game design practice.

RADDAR also has possible implications for the philosophical interpretation of design practice. The epistemological and ontological perspectives within the constructivist paradigm differ significantly from those of conventional inquiry. By identifying similarities between constructivist inquiry, as an action research methodology, and the process of design, allows for the possibility of transferring these philosophical orientations into the context of design, thereby offering design practice a new interpretation. Such interpretations lie beyond the scope of this paper.

Further, by transferring constructivist inquiry into the context of design to the, RADDAR can be understood as a *constructionist* method of inquiry.

Constructionism—the N word as opposed to the V word—shares constructivism’s connotation of learning as “building knowledge structures” irrespective of the circumstances of learning [...but adds] that this happen especially felicitously in a context where the learner is creating a public entity, whether it’s a sand castle on the beach or a theory of the universe. Papert in Harel and Papert (1991, p. 1)

Constructionism, therefore, can be understood as ‘value-adding’ to constructivism by including the context of design and can be thought of as “learning through design” (Kafai, 1995, p. 1), a view wholly consistent with the design process being a learning process. In effect, RADDAR, by adopting design as its context and extending constructivist learning into the realm of constructivist inquiry, extended constructionism from a theory of learning to a method of inquiry. Further, integral to constructionist learning is the notion of an “epistemological pluralism” (Turkle & Papert, 1990, p. 128) which accepts the “validity of multiple ways of knowing and thinking” (Turkle & Papert, 1991, p. 161). Similarly, RADDAR, as constructionist method of inquiry and as with all qualitative research approaches, allows for both qualitative, such as hermeneutic phenomenology (Taylor, 1997), writing as inquiry (Richardson, 2000), ethnography (Van Maanen, 1988), and qualitative interviews (Kvale, 1996), and quantitative research methods, such as the survey (Cohen & Manion, 1994) to be combined. Adopting a multiplicity of approaches, as required by qualitative research, provides a means for methodological triangulation or “crystallization” (Janesick, 2000, p. 392).

Conclusion

Digital game design is an inherently complex, multifaceted and predominantly mysterious process, however by researching game design, we aim to unmask the process and better understand its nature. RADDAR (Research as Design-Design as Research) is a methodological approach fundamentally grounded on the key concepts of the design process being a research process and the methodology of constructivist inquiry. The core dynamic of RADDAR is a hermeneutic dialectic whereby through continuing iterations of analysis, critique, reiteration, reanalysis and so on a joint construction of a case can emerge, a process also familiar to iterative design. Dialogue, therefore, is essential not only in comparing and contrasting

various views within a hermeneutic dialectic, but also is a concept that lies at the very heart of design. By extending the notion of 'participant' originally found in constructivist inquiry to include the designer's materials, RADDAR allows for designers/inquirers to incorporate the various conversations with materials designers enact during design activity into their research. Further, as an action research methodology, the key outcomes of a RADDAR inquiry are both action, including an artifact as a deliverable, and research with a case study as a deliverable. However, depending on individual circumstances, the focus may shift more toward one than the other.

Although modified, the adoption of the established research methodology of fourth generation evaluation, allows for a number of evaluation, or quality, criteria to be transferred to design inquiry, thereby providing a means for judging inquiries that adopt RADDAR. Further, as a qualitative research methodology, RADDAR is simply one of a variety of qualitative and quantitative methods a designer/researcher can choose in investigating design activity. This view is reflective of constructionism's notion of an epistemological pluralism which accepts variety of ways of knowing and thinking. Accordingly, as a constructionist research methodology, RADDAR can be shaped to suit the particular needs, foci and design contexts of individual inquirers.

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