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Educating the Theorist-Practitioner

Fostering Digital Competence with Interactive Digital Media Research Studios

Abstract

There are very real opportunities for innovative research and development in the emerging field of interactive digital media: new forms of entertainment, education, social services, and the like. But where will the innovators actually come from? For all the popular rhetoric in the world today about "educating a new generation of innovators," for the most part the institutional structures of higher education still look as if they are either training students to be traditional scholars of new media – or simply training them to be skilled developers of existing products and applications (e.g., conventional computer games). This paper argues that university-based interactive digital media education needs to train a different kind of digital literacy and competence: that of a theorist-practitioner. And such an education requires a digital *research* studio focus.

1. Introduction

Although I have a research and industry background in the design of advanced media technologies, in recent years I have also been teaching university courses in different parts of the world. In the process of training students to design innovative digital technologies, there are a number of interdisciplinary challenges that arise.

Consider the following situation from the university course I teach in game design. One of the design problems is to make a computer game automatically increase the game-play difficulty based on player performance. This is a well-known technique for having games automatically adapt to players. In *Tetris*, for example, the speed of the falling blocks is automatically increased as the player succeeds at clearing more and more blocks. For some things, it is relatively easy to determine "what makes something more difficult" – it can involve an increase in speed (or quantity) or a reduction in size. In other cases it is more challenging to identify what makes something more difficult; what makes one maze or logic puzzle harder than another?

However, even the "easy" design options raise interesting questions and challenges. Recently, one of the student teams was working on the design of its game. In the game, the goal was to shoot and hit falling targets. They were considering two different ways they could make the game difficulty increase automatically: increase the speed of the falling targets – or decrease their size. As part of their discussions they were also asking people to playtest their prototype, discussing the alternatives with the players, and so on. Ultimately, they decided to have the game increase in difficulty by having the targets fall faster. Their reason: players seemed to find this kind of difficulty-increase *more enjoyable* than the alternative.

This is an interesting hypothesis. Is it correct? How can we test it? Will the results of such tests suggest other important design rules or heuristics? Can we use such insights to identify other game parameters that make games more interesting or enjoyable? Traditional art training might help students to *make* things that are engaging, but it does not typically train them to pursue such questions. On the other hand, although conventional computer science helps prepare students to specify requirements, create an efficient implementation, and the like, it rarely has much to say about how to make products that are emotionally engaging.

This story highlights a number of challenging issues about the relationship between theory and practice, about our failure to adequately train university students for existing and emerging research and industry opportunities, and about even larger opportunities that *could* be identified and developed if the appropriate kinds of training existed.

Contemporary interactive media are becoming more complex and are being designed to support a wider range of activities than ever before. Such media support artists, gamers and researchers – people who have different goals, different ways of working and playing and different needs. Furthermore, depending on the context, people expect interactive media to function as anything from intelligent servants when booking flights to intelligent opponents in online games. This raises a number of foundational design questions that draw on such diverse fields as cognitive science, media studies, computer science and engineering, and art/design theory.

There are very real opportunities for innovative research and development in the emerging field of interactive digital media: new forms of entertainment, education, social services, and the like. But where will the innovators actually come from? For all the popular rhetoric in the world today about "educating a new generation of innovators," the institutional structures still look as if they are either training students to be traditional scholars of new media – or simply training them to be skilled developers of existing products and applications (e.g., conventional computer games).

Conventional economic wisdom currently argues that wealthy nations are transitioning to economies based on "creativity" while manufacturing/implementation is migrating (being "outsourced") to developing nations. To the extent that this is true, there is something paradoxical about a manufacturing model of education serving as a basis for

training "creative industry" scholars, engineers and designers. Although the model of "students coming off an educational assembly line" may be reasonably successful in the case of training students to work in well-established fields creating known products and services, it seems quite problematic for preparing students for their roles in a rapidly-changing world of innovation. There will certainly be creative jobs analogous to established vocations such as, say, literary criticism or animation or software engineering. But since we know precious little about how to design engaging interactive *experiences*, there is tremendous opportunity in "inventing the future" of interactive digital media – not just the technical infrastructure, but the media/technology that *meets the end-user*.

Is there demand? Indeed, there is tremendous unfulfilled demand from students, industry and the research community. In our experience, students are deeply frustrated when they must choose between, say, a computer science education (with a smattering of interactive media lectures or courses) or an arts/humanities education (with barely a smattering of technical lectures or courses). Likewise, research and industry are desperate for individuals who have a combination of skills and experience – not just "designers who know how to *talk* to programmers" and vice versa.

The needs of computer-game design, to take just one example, challenge a number of educational traditions and assumptions about the division between academic scholarship, vocational "skills" and tacit artistic expertise. There are, of course, scholarly courses on game studies, vocational programmes to prepare individuals for jobs in the game industry, and so on. But there is an alternative: a *theorist-practitioner* approach to interactive media design education. Such an approach is an alternative to both "the main purpose of practice is to make theory more concrete" and "the main purpose of theory is to inform practice." The theorist practitioner approach is one that combines the development of new theory with the creation of innovative works.

2. Why isn't this problem being addressed?

One of the biggest barriers to addressing this problem is the institutionalized Balkanization of formal education.

To be sure, there is something of a tradition in academia of letting students take (a few) applied courses to make the (important) theory concrete. And there is a tradition of arguing for the importance of theory in the training of skilled professionals. And certainly, art schools have invoked theory and more scholarly study in the form of anatomy, mathematics, and the like. However, there is a deep division that still persists between scholarship, vocational training and the creation of engaging and meaningful artifacts/experiences. Such divisions manifest themselves in various forms of Balkanized education: divisions between universities as "centers of scholarship", trade schools as centers of vocational training and art schools as centers of "art production." Such divisions and antagonisms even exist bet-

ween faculties within the same university, where scholarly subjects are opposed to applied subjects (e.g. computer science, engineering, medicine, architecture).

To give one example, "human computer interaction" (HCI) is an important field that has emerged over the last 20 years. And yet, even today, there is utter confusion and chaos about "where it belongs" in a university. Should it be in a humanities faculty (*human*-computer interaction) or in computer science (human-*computer* interaction). The dilemma is so real that many universities put it in *both* (and then endure endless turf-wars between the two). And since such programmes are not actually inter-disciplinary, they wind up discouraging or rejecting students who are genuinely interested in combining, say, programming with the design of innovative end-user products and services.

The particular example of HCI is just one of the more general cases: the requirements for developing engaging and important *end-user* interactive technologies requires a combination of skills and interests that cannot be adequately addressed by the current separation of scholarship/theory, design/implementation "skills" and fine art techniques. To give one concrete example: what kind of education currently prepares people to invent new attractions for amusement parks? This topic is often deemed "conceptually uninteresting" for university education, too "psychological" or "high level" for vocational schools and polytechnics and too "concerned with research about what the audience wants" for many art schools.

This Balkanization is not just institutionalized by tradition and inclination, but also by funding and government-level policy decisions. Such agencies "naturally" view universities as the source of scholars, polytechnics as the source of skilled technicians and art/design schools as the source of people who "make things that engage people".

And the loss is not just in the form of amusement park attractions, but consists of countless other emerging (and yet-to-be identified) possibilities that include interactive digital media systems that automatically generate innovative entertainment, art, education and health-care.

3. What We Could Do

This paper argues for the importance of the theorist-practitioner. Readers familiar with the work of Donald Schon will recognize the allusion to his concept of the "reflective practitioner" [Schon, 1983, Schon, 1987a]. Schon argued that practitioners should (and do) "reflect" on their practice. That is, skilled activity is not simply some vocational execution of learned skills, but involves complex forms of reflection, hypothesis-formation, modeling, and the like.

...reflection-in-action ...involves a surprise, a response to surprise by thought turning back on itself, thinking what we're doing as we do it, setting the problem of the situation anew, conducting an action experiment on the spot by which we seek to solve the new

problems we've set, an experiment in which we test both our new way of seeing the situation, and also try to change that situation for the better [Schon, 1987b].

For a variety of reasons, Schon was criticizing what he considered academia's excessive emphasis on a particular (positivist) model of "theory." This particular notion of theory is one inherited from the hard sciences, where the emphasis is on generality. But whereas greater generality is a sign of success in the hard sciences, it is often at odds with professional needs and interests. Hence the ongoing tension between academic and professional views on theory and knowledge.

It may seem as if there is a difference between the model of the reflective practitioner and the theorist-practitioner. But actually, the concept of the theorist-practitioner seems quite resonant with Schon's model in that it emphasizes the value of particular *kinds* of theory and knowledge that are often not appreciated or recognized as such in academia: *design* theory and knowledge. And there is a desperate need to provide suitable educational opportunities for such theorist-practitioners.

There are a number of examples that are typically invoked as models of such education (e.g. Vkhutemas/Vkhutein, the Bauhaus, the Ulm School, the MIT Media Laboratory). But for all their pioneering efforts, none of these actually tried to seriously engage with a circulation between theory creation and innovation practice. The Bauhaus and the Ulm School, for example, each contributed to an enlarged notion of design for a mechanical age – and each proposed pedagogical innovations in this regard [Wick, 2000, Museum, 2003]. But although many of the artists and designers who taught at these institutions circulated between the development of art/design theory and the creation of works, this circulation was not part of the core of the pedagogy. In other words, it seems that mostly it was the *teacher-artists* who were working through new theoretical concepts (as opposed to nurturing this in students).

Indeed, perhaps the best examples are elsewhere. The Polish Laboratory Theatre, for example, investigated the relationship between performer and audience by constantly circulating between the creation of theatre productions and the development of innovative performance theory [Grotowski, 1975]. Similarly, the work of architect Christopher Alexander is an ongoing circulation between the creation of actual architectural structures and the development of a new theory of architectural design [Alexander, 1987]. Some of the early work of architect William Mitchell also provides a good example of innovating in design theory and the development of new architectural forms [Mitchell, 1990]. And computer scientist Terry Winograd has been arguing for a "design perspective" in software development [Winograd, 1996] – one that keeps the focus clearly on such issues as, "how does the way that you build it interact with the way it will be experienced and used?" [Winograd, 2000].

These are not examples of "learning theory to be a better practitioner", but rather learning how to use theory to innovate in practice and how to use the results of practice to inform advances in theory.

4. What Will It Take?

To address this will require at least three kinds of effort. First, effort to overcome "disciplinary Balkanization": the development of institutional structures that make it possible for the creation of truly new and interdisciplinary forms of education. Second, the development of *digital research studio* programmes for interactive digital media. And third, an honest re-appraisal and redesign of institutional structure/requirements in the light of the realities of such research studio programmes.

4.1 Beyond Disciplinary Balkanization

We have already noted the traditional battle between "scholastic" focus and (mere) training in "skills." This separation is especially problematic when interactive media are designed to support human goals. Traditionally, computational media supported such things as *calculations* (census, airplane trajectories, finance). In recent years, they support a much broader range: finding information, booking/purchasing, playing games, creating art, modeling phenomena, supporting learning, and the like.

It is rare for courses to explore the interaction and potential synthesis of concepts and theories. In particular, to the extent such synthesis is attempted, these are often half-hearted extensions of arts/humanities subjects (in the direction of technology) or computer science subjects (in the direction of arts/humanities). To take one example of potential synergy in the field of interactive digital media, the coverage of computational concepts is often unsuitable for both arts/humanities students *and* (surprisingly) for computer science students.

There is an assumption that "introductory" courses can be designed and run independently of any concern for the particulars of students. An introductory programming course, for example, will be radically different if the goal is to prepare students for further work on inventing computational forms of entertainment rather than, say, implementing database-driven Web sites. The required computational knowledge and skills may *look* the same from the perspective of a computer science faculty, but they look very different for students with background in the arts who want to learn to work with computer programming as an expressive medium analogous to paint or clay. (And such courses look very different for a computer science student who wants to learn about computational techniques that are relevant to the specifics of end-user interactive media.) Standard computer science programming examples and exercises assume a particular background – and a particular future of training and interest. The same argument can be made for an introductory art course; it looks very different if the students are humanities students who plan to become critics or theorists – or if the students are computer scientists who want to learn a new set of aesthetic concepts and methods of evaluation for the practice of creating interactive/digital art. Programming students who take art appreciation modules are often frustrated when they do not learn much about how to *make* things that

have particular aesthetics – nor even much about how to *evaluate* works of art in ways that pertain to then *representing that knowledge computationally*.

Given such student concerns, it is simply heartbreaking when brave individuals from one faculty or another try to address this student-need – and are vetoed by a "competing" faculty with an explanation to the effect that "if any faculty will teach that subject, we will teach it – but we will never teach it". Ultimately, the losers in this all-too-common scenario are the students, the interested faculty members, the research community, industry, and, yes, society at large.

4.2 Beyond the Studio Model

One could argue that the issues being raised here are already addressed by a "studio" (or "lab") approach to digital art/design. But one aspect of this disciplinary Balkanization is the assumption that universities (largely) train students for further participation in research – and art/design schools prepare students to work as practicing artists/designers. This ignores the very real need for interactive digital media *research* – so, it excludes the undergraduate *preparation* for such things.

One might also argue that theory is already taught in the context of industrial design. But such theory is typically theory in the service of a particular kind of practice; it is not about how practice can inform the development of new design theory. What is needed is a practice-based approach to design education that nonetheless emphasizes understanding and *developing* theory – rather than simple "skill training."

A digital research studio would help students develop experience inventing, managing and evaluating their own work. Such work would involve project-based team-work with the right balance of rigor and creativity. For project-based courses, it is not usually appropriate to have some strictly defined goals, but rather to provide broad but clear constraints, regular feedback and distinct challenges that help students address issues they may not have considered – and even to arrive at insights and solutions of their own.

Students would work in small teams towards a final project – and each team would be required to submit weekly deliverables that build towards the final work. This project-work would involve all the aspects of any research/development project: identification of suitable focus (problem, target user-group, etc.), requirements gathering, prototyping and evaluation. Along the way, they would read relevant literature, study examples of related work, learn research and evaluation methods and discuss various ways to analyze and apply insights to the ongoing project-work. This would also involve collective discussions and analysis of student work which would allow students to be in the role of both creating and critiquing work. Broadly stated, by the end of such an education, students will know how to engage in the process of inventing, creating and evaluating something new and valuable – and will know how to work effectively with others to do this. Further, they should have some appreciation of how their work fits in the context of work done by others on similar topics.

Of course, in many ways this sounds similar to project-oriented courses in computer science, engineering or the arts/humanities. There are, for example, studio-based courses where artists learn many tacit skills for the creation of engaging artifacts – and similarly, there are lab-based courses where computer scientists and engineers develop the skills to apply specific techniques to the solution of particular kinds of problems. But how can we train students to, for example, invent an appealing and appropriate game that helps researchers understand the spread of infectious diseases in real time? The claim here is that we need something quite new: a studio-based focus on *design innovation in end-user oriented interactive digital media*.

4.3 Re-evaluating Education

The existing model of university structure is largely unchanged from the European model of the 1800s. It still assumes that such education is largely in the form of a lecturer speaking in front of a large auditorium of students who will then read additional works and write essays. The difficulties engendered by these assumptions are widely discussed elsewhere, but it is worth highlighting two problematic consequences specific to team-based project-oriented interactive digital media education: the problem of *scale* and the problem of *process*.

Project and studio-based education raises particular kinds of challenges, whether such courses are in computer science or in the arts. The assumption behind such education is that much of the professional-life is project-based, involves collaborative work and relies on disciplined habits of work as much as particular individual skills and knowledge.

For a traditional lecture model, adding more students has almost no impact on the teacher (especially if this is combined with multiple-choice exam questions that can be automatically marked). It is just as easy to lecture to 300 students as it is to lecture to 100 students. This is the essence of manufacturing optimization; from the perspective of the university, it just makes good economic sense to increase the scale. But if there is a switch to project-based team-work, this model is not just "more costly", it is *fundamentally wrong*. As everyone knows who has ever managed a group of people, the *management requirements increase logarithmically as a function of the number of people involved*. It is, in fact, the opposite of "adding *many* more students only requires a *few* more resources"; for courses that involve teams and projects, adding a *few* more students requires *many* more resources.

Furthermore, team-based project-oriented work needs to promote good practice, not just good results. For example, in professional life it is very important to make *regular progress* – rather than try to "cram it all in at the end." But project-based pedagogy that emphasizes *process* runs into problems in an educational model premised on such things as "final exams." It is not merely that the examination model shifts to such things as "continual assessment," it raises problems about what it means to do "make up exams." In

other words, in the traditional university tradition (especially in Europe), the model of what it means to "pass" a course is to *pass the final exam*. Students do not need to attend the lectures or otherwise interact with other students to pass the course. Indeed, there are *regularly scheduled final exams* for each course – and if a student does not succeed during one of these exams the student may try again later. This may be well and good for a course where the evidence of successful learning can be in the form of a several-hour demonstration. It is less tenable where the "demonstration" is in the form of such ongoing things as submitting regular deliverables, meeting deadlines, adjusting to unexpected project-events, and the like. How can one possibly structure a several-hour final examination for a student that is intended to be comparable to the efforts of a student on a team-based project during a three month-period?

These issues compound the need for a fundamental re-examination of university structure in the light of the needs of emerging industries and educational requirements.

5. Conclusion

This paper began by sketching a scenario in which particular kinds of design problems arise. Students need opportunities to raise such questions – and support to be able to discover and invent the answers to them. But the needs are not simply restricted to the creation of new kinds of courses. This needs to be part of a larger activity in which there is a circularity between research and education, one in which students participate in both. Students can – and should – be included in the development of new technologies and theories. And the results of such research can and should feed back into the courses of their fellow students.

We should create interactive digital media research studios to support a new form of digital apprenticeship: something that supports the legitimate participation of student theorist-practitioners who circulate between the creation of working artifacts and the creation of theories about the design of such artifacts.

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