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Play and flow: Implications for online learning

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Abstract

Many of the diverse pleasures that people experience during recreational computing activities can be synthesised into a single concept known as flow. Flow is a state of intense mental focus that occurs when a person's perceptual and cognitive systems are challenged at near capacity without being exceeded. It typically results in feelings of enjoyment and reduced awareness of factors that are irrelevant to the task at hand. For example, sometimes while surfing the Web or playing computer games, people become so immersed in what they are doing that they lose track of time and temporarily forget about their physical surroundings, their sense of self and their usual concerns. Flow experiences are not limited to computing activities. People report experiencing flow while working, participating in sport, performing music, engaging in hobbies, and doing many other things. This paper suggests some instructional design principles that could potentially make online learning more conducive to flow experiences, and hence more enjoyable and intrinsically motivating. These suggestions have arisen from the findings of a qualitative study of the flow experiences of Web users and computer game players.

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Introduction

Many people willingly devote significant amounts of time and energy to recreational computing activities such as surfing the Web and playing computer games. A recent random-digit-dial telephone survey of 2 513 adults in the United States found that 13.7% of respondents (more than one in eight) found it hard to stay away from the Internet for several days at a time. The same study, carried out by researchers at Stanford University School of Medicine, also found that 12.4% of respondents stayed online longer than intended very often or often (Aboujaoude et al., 2006).

Similar devotion can be found among game players. A survey of 2 982 players of massively multiplayer online role-playing games (MMORPGs) revealed an average playing time of 21.9 hours per week (Yee, 2004). In a separate survey of 91 MMORPG players, 58% of the participants recalled spending more than eight continuous hours playing in one session (Ng & Wiemer-Hastings, 2005).

The time and energy that many people willingly invest in recreational computing activities prompts the question: Is there some way of getting the same devotion to online learning environments?

Flow experiences

The glue that keeps Web users and game players fixed in front of their computer screens longer than they planned to be there is a phenomenon known as flow (Chou & Ting, 2003; Pace, 2004; Sweetser & Wyeth, 2005; Chen, 2006). Flow is a state of intense mental focus that occurs when a person's perceptual and cognitive systems are challenged at near capacity without being exceeded. It typically results in feelings of enjoyment and reduced awareness of factors that are irrelevant to the task at hand. For example, often while surfing the Web or playing computer games, people become so immersed in what they are doing that they lose track of time and temporarily forget about their physical surroundings, their sense of self and their usual concerns. Consider the following description of a flow experience from a game player who was interviewed by the author.

> I used to play all the time at home and the computer was in the middle of the house. There were people walking past and what not. Mum would be talking to me and it wouldn't even register that she was speaking. I would just be sitting there playing away. You'd look up and a couple of hours had gone by, and you didn't even realise.
> —22-year-old male game player

Flow experiences are characterised by some common elements: a balance between the challenges of an activity and the skills required to meet those challenges; clear goals and feedback; concentration on the task at hand; a sense of control; a merging of action and awareness; a loss of self-consciousness; a distorted sense of time; and the autotelic experience (Csikszentmihalyi, 1975, pp. 35–54; 1990, pp. 48–70). The term 'autotelic' refers to an activity that is "done not with the expectation of some future benefit, but simply because the doing itself is the reward" (Csikszentmihalyi, 1990, p. 67).

This paper suggests some instructional design principles that could potentially making online learning more conducive to flow experiences, and hence more enjoyable and intrinsically motivating. These suggestions have arisen from the findings of a qualitative study of the flow experiences of Web users and computer game players. Although Web use and game play are not considered to be learning activities in the traditional sense, our understanding of how these activities engage participants suggests possible strategies for engaging online learners. Further research would be required to test these propositions in an online learning environment.

Flow and learning

Games and play are ideal flow activities because they provide participants with clear goals, well-defined rules, obvious challenges and constant feedback on performance. However, flow experiences are by no means limited to games and play. People report experiencing flow while working, participating in sport, performing music, engaging in hobbies, and doing many other things (Lefevre, 1988; Jackson & Csikszentmihalyi, 1999; Custodero, 2002). Almost every kind of activity can be structured to facilitate the experience of flow, including learning activities.

Many researchers propose that there is a direct relationship between flow and learning. Gaines (1997, p. 294) describes flow as "an optimum learning state." Goleman (1995, p. 93) argues that "mastery in a craft or skill is spurred on by the experience of flow—that the motivation to get better and better at something, be it playing the violin, dancing, or gene-splicing, is at least in part to stay in flow while doing it." Craig et al. (2004) found a positive correlation between flow and learning in an exploratory study that tracked the emotions of college students while they interacted with a computer literacy tutoring system.

Consider one study in detail. Nakamura (1998) demonstrated that the difference in performance between two equally capable groups of mathematics students was related to the fact that during periods of study the high achievers experienced flow twice as often as the low achievers. The study participants were students of superior mathematics ability attending a Chicago high school. All of the participants had scored in the top 10% on a national test of academic potential and in the top 5% on the maths section of the test.

Although the students had very similar levels of mathematical ability, they differed in terms of academic achievement. Maths teachers rated each student on a nine-point scale in response to the item "Compared to what you see as this student's potential, their actual performance is ___." The top third of the sample were defined as high achievers, and the bottom third were defined as low achievers. For seven days, each student carried a pager that signalled them once at random within each two-hour period between 8.00 a.m. and 10.00 p.m. Whenever they were signalled by their pager the students completed a self-report form, providing information such as what they were thinking about, what they were doing and how they felt.

The self-reports revealed that the high achievers spent about 27 hours each week studying, much more than the 15 hours of study done each week by the low achievers. High achievers experienced flow during study for 40% of the time they devoted to it, while low achievers experienced flow during study only 16% of the time. More often than not, study produced feelings of anxiety for the low achievers because the demands exceeded their abilities. Nakamura concluded that high achievers invest the time in study that is necessary for the development of their intellectual potential because they experience flow, while low achievers study less in order to avoid anxiety.

The links between flow and learning that are evident in the literature suggest that fostering flow experiences for online learners is a worthwhile endeavour.

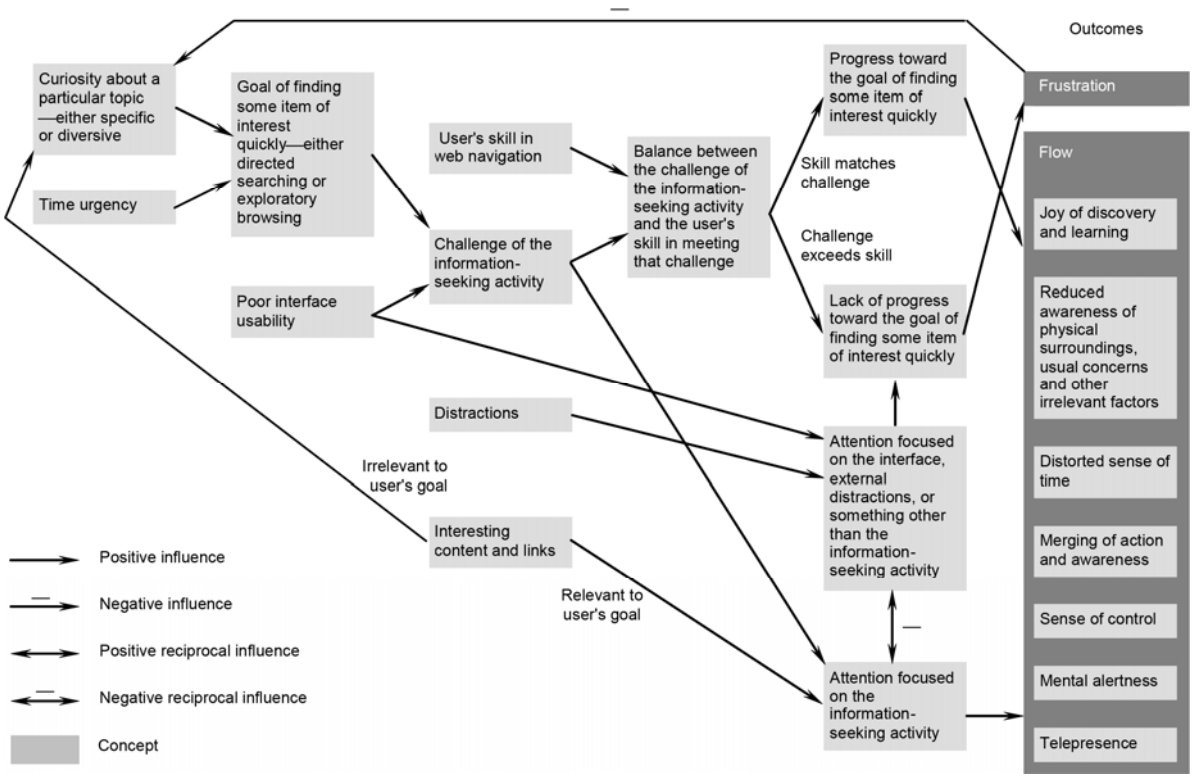
Web use, game play and flow

Pace (2004) has proposed a grounded theory of the flow experiences of Web users engaged in information-seeking activities (see Figure 1). This theory evolved from in-depth interviews with twenty-two informants of varying gender, age, educational attainments, occupations and Internet experience who could recall experiencing flow while using the Web. The informants were selected according to their potential for developing new insights using a procedure known as theoretical sampling. Unlike statistical sampling, which aims to be representative of the population under study, theoretical sampling aims to maximise opportunities for exploring emerging concepts and relationships. Sampling continues until the study

achieves theoretical saturation—the point at which additional data is no longer adding to the concepts and relationships being developed.

Figure 1: Concept map depicting a grounded theory of the flow experiences of Web users

Source: Adapted from Pace, 2004



The interview data was analysed using the grounded theory research method—a constant comparative method of analysis with three stages:

1. open coding, which involves breaking the data down into significant concepts and properties
2. theoretical coding, which involves reassembling the concepts with propositions about their relationships to each other
3. selective coding, which involves delimiting the analysis to only those concepts and relationships that are related to the core explanatory concept.

Glaser (1978, 1992, 1998) provides a comprehensive explanation of the grounded theory research method, and Pace (2004) provides a more detailed description of its application to the aforementioned study.

Following Pace's initial research, a second study was undertaken to explore the flow experiences of computer game players. This second study, which is still in progress, is employing a similar research method to analyse interview data from individuals who can recall experiencing flow while playing computer games. The following sections discuss some of the findings from these two studies as they relate to online learning environments.

Clear goals and meaningful feedback

Most flow experiences are reported to occur within activities that are goal-directed and bounded by rules, allowing the participant to achieve an ordered state of mind (Csikszentmihalyi, 1990, p. 72). In everyday life, at home or on the job, people often engage in activities without being consciously aware of their purpose or of how well they are doing. In contrast, flow activities allow a person to focus on clear goals and to receive meaningful feedback.

Pace (2004) has demonstrated that goals are an important characteristic of the flow experiences of Web users and game players. Web users, for example, engage in two general types of navigation behaviour: a directed searching mode in which they are motivated to find a particular piece of information, and an exploratory browsing mode that is more experiential in nature and characterised by diffuse motives such as passing time or seeking stimulation. Regardless of which navigation mode a Web user is in, the individual has a goal of finding some item of interest quickly. The item of interest may be as specific as the answer to a particular question or as vague as somebody's definition of an interesting site, but the fundamental goal is the same in each case. To illustrate this point, consider the following comments from two Web users—one who experienced flow during a directed search and the other who experienced flow while browsing for stimulation.

> *I was looking for the geographic centre of Australia for somebody.* It ended up being quite complex finding it … I said "Right, I'm going to spend half an hour doing this". But I was so tantalisingly close in so many of these sites I thought "It's got to be here somewhere". And I ended up spending more time on it than I expected. It got me in … That one was actually quite exhilarating because when I did eventually find it, I was so pleased—ridiculously pleased. I was leaping around all over the staff room, and everyone was sort of looking at me as if I'm nuts.
> —55-year-old female Web user

> Some nights … there's nothing good on TV so you jump on the computer and *just start and think of something you want*, and a couple of hours later you're still sitting there.
> —35-year-old male Web user

The feedback on a Webuser's actions is the appearance of a new page. Every time a Web user clicks a link, he or she can quickly tell how well the current search is progressing by inspecting the new page that appears. The speed at which a new page appears depends on factors such as the size of the files being transferred from the host Web server, the speed of the user's modem and the bandwidth of the user's network connection. Slow downloads interfere with the user's ability to maintain focused attention on the task at hand, and may even lead to frustration (Pace, 2004).

The flow experiences of Web users and game players suggest that online learning activities should provide clear goals and meaningful feedback if they are to be conducive to flow experiences. Reisetter and Boris (2004, p. 277) also identify clear goals as one of "the most important elements for learner success" in an online learning environment. Almost any goal, if sufficiently clear, can serve to focus attention long enough for one to achieve a flow experience (Csikszentmihalyi, 1993, p. 180). A goal need not have any social or economic value; its value is

simply that it gives learners an opportunity to express their potential, learn about their limits and improve their abilities. In a similar vein, almost any kind of feedback can be enjoyable, provided it is logically related to a goal in which one has invested attention (Csikszentmihalyi, 1990, p. 57). What makes feedback valuable is the symbolic information it contains about how close one is to achieving one's goals.

Interest

The goals provided by an online learning environment should be of interest to the learner if they are to encourage flow experiences. The important role that interest plays in the flow experiences of Web users is evident in the following comment.

> It's something that can hold my interest. Obviously if it's something your boss makes you do and you really don't want to be doing it, it's hard to get into it … If you're looking for something that you're personally interested in, I think it's quite easy to slip into that flow sort of state.
> —21-year-old female Web user

Catering to the interests of individual learners might mean offering them choices within a differentiated curriculum. Gardner's (1999) multiple intelligence community advocates "individually configured education" that crafts curriculum, pedagogy and assessment to suit the intellectual strengths and interests of individual students. As appealing as this notion sounds, even Gardner (1999, p. 153) acknowledges the difficulty of implementing it on a wide scale. The problem of identifying the interests of individual students and then personalising an online learning environment to cater for those interests would be a worthwhile topic for further research.

Other approaches to engaging the interest of students might be found in the practices of the authentic learning community. Authentic learning is the idea of involving students in a process of meaningful inquiry to solve real-world problems that extend beyond the classroom (Rule, 2006). For example, students may work on problems that are connected to their personal experiences or contemporary public situations (Newmann & Wehlage, 2001). Yair's (2000, p. 205) examination of major instructional reform efforts in US schools suggests that "students are academically stimulated in instructional units that are authentic, choice-driven, and demand skills."

Balance between challenges and skills

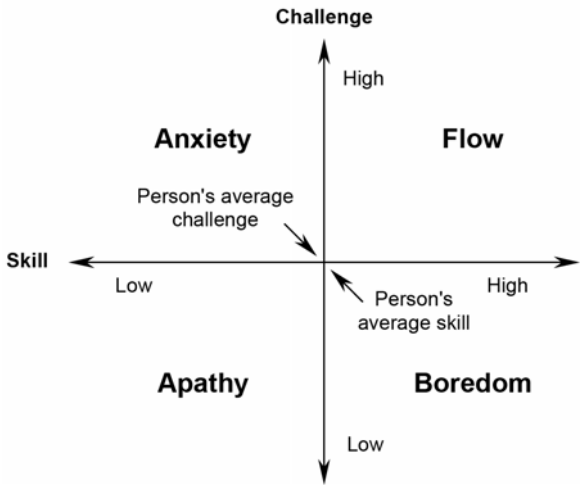
A universal precondition for the flow experience is that the challenges an individual faces in a particular activity are equal to the skills he or she uses in meeting those challenges (Csikszentmihalyi, 1997, pp. 30–31). Flow theory suggests that if the challenges of an activity are too high relative to one's skills, one experiences anxiety. If challenges are too low, one experiences boredom. If challenges and skills are both low, one experiences apathy and the overall quality of the subjective experience is the lowest. If challenges and skills are both high, the likelihood of experiencing flow is maximised and the overall quality of the subjective experience is the highest (see Figure 2). To illustrate this idea, consider the following contrasting comments from two game players—one who experiences flow while playing the challenging strategy game *Warcraft*, and the other who is bored by racing games because they fail to challenge him mentally.

> In *Warcraft* you've got to try and build a town and then an army that can challenge and defeat the opposing teams. And in doing that, you've got to manage your resources and your population and all sorts of things like that. So it makes you work out how you're going to do that. And then you've got to set to and do it. And while you're doing that, the other team might be attacking you. You've got to take in factors like that. So it makes you think constantly.
> —22-year-old male game player

> Some of the sports ones and racing games I don't really get into. I play them occasionally, but they just really don't do anything for me. I get bored with them a lot quicker … There's not much to make you think in them. You're just watching the scenery go by, steering yourself through it … So I get tired of them fairly quickly.
> —15-year-old male game player

Figure 2: The four-channel flow model

Source: Adapted from Jackson and Csikszentmihalyi, 1999, p. 37



Given that high skills and challenges constitute an important prerequisite for flow, it is reasonable to suggest that online learning activities should continually challenge the learner if they are to be engaging. Problem-based learning materials achieve this aim by anchoring all learning activities to a larger task or problem, and providing appropriate support for the student (Savery & Duffy, 2001). The challenge must not be so difficult that it creates a sense of frustration, nor so easy that it produces boredom. Like a good computer game, the learning tasks should progressively increase in difficulty as the student makes the transition from one level to the next. Self-paced learning materials give students further opportunities to match the challenge to their level of skill.

Focused attention

The higher-than-average challenges associated with flow activities require a complete focusing of attention on the task at hand, or as Csikszentmihalyi (1975, p. 40) puts it, "a centering of attention on a limited stimulus field." An important by-product of this fact is that flow leaves no room in one's consciousness for irrelevant thoughts, worries or distractions (Csikszentmihalyi, 1990, p. 58). Consider the following comments from a Web user and a game player as examples.

> I lose track of everything to be honest. I'm focused on the computer. My cat can come in and sleep on the couch, and the windows can blow and paper can blow around on the floor. Not major things, but little things like that. And I'll just pretty much be focused on the computer.
> —17-year-old male Web user

> Me and the game. Whenever I play a game, nothing matters. Nothing matters except the game. Nothing really in the corner of your eye could take your attention away from the game. It's just you and the game, and that's pretty much it.
> —14-year-old male game player

People who experience flow frequently report that, while it lasts, they are able to forget about the unpleasant aspects of life. In everyday life, one's concentration is rarely so intense that all preoccupations disappear from consciousness, but that is precisely what happens in a flow experience. All of the troubling thoughts that normally occupy the mind are temporarily suspended while the pressing demands of the flow activity consume one's attention.

Not even the passage of time enters a person's consciousness during flow if it is irrelevant to the task at hand. Time seems to pass faster than usual because "attention is one of the most important psychological processes that regulate the experience of time" (Brown & Boltz, 2002, p. 600). The following comment from a Web user describes the distorted sense of time that people typically experience during flow.

> I kept exploring the links in this site and it was very interesting—the information I was finding. Before I knew it, easily half an hour was gone, and I thought it was only five minutes.
> —20-year-old female Web user

Computer users tend to ignore minor distractions during flow because their attention is focused on the task at hand, but some distractions cannot be ignored. A flow experience may be interrupted by environmental distractions such as loud noise, people talking or a ringing telephone; physiological distractions such as hunger, fatigue or a need to use the toilet; and computer-related distractions such as software error messages, a broken Internet connection, or a browser that stops responding. Any external stimulus that has sufficient intensity, frequency or importance to cause a shift in the user's attention will terminate a flow experience (Pace, 2004).

Poor interface usability can also be a distraction for computer users. Since attention is a limited resource, the more attention that is demanded by a user interface, the less that is available to focus on the task at hand (Kahneman, 1973). A poorly designed interface can disrupt a flow experience by demanding an excessive amount of attention. Slow response times, disorganised content, inadequate navigation support, incoherent page layout, inappropriate colours, stale links and unnecessary pop-up windows are examples of potential problems (Pace, 2004). Interface usability is one area where designers of online learning environments can actively try to minimise the distractions faced by users, and thereby maximise the opportunity to experience flow.

Rich sensory experience

The preceding section discussed how the higher-than-average challenges of a computer game or Web activity can focus a user's attention on the task at hand. The rich sensory experiences provided by some computing environments can also help to focus the user's attention. Brown and Cairns (2004, p. 1299) explain that "if gamers need to attend to sound, as well as sight more effort is needed to be placed into the game. The more attention and effort invested, the more immersed a gamer can feel." The following comments from a game player and a Web user illustrate this point.

> It was just like you were in the game as the main person. When you're walking down the street people talk to you, and it's like they're actually there with you. I couldn't hear or see anything else but the game. It was like it was my life. I could control how it changed.
> —15-year-old male game player

> I hadn't seen that level of interactivity before in a site. It really caught my interest. You could walk through, and there were not just different communities set up, but different worlds set up. So you might step through and you'd be at the Grand Canyon, or on the surface of Mars. There were no limitations. A lot of work had been put into it. I think for me, with flow, when I forget that it's just a group of pictures, when I forget that it's just text and a bit of HTML code in the background—that for me is flow.
> —26-year-old male Web user

Draper, Kaber, and Usher (1998) note that various terms are used in the literature to describe the displacement of a user's self-perception into a computer-mediated environment—presence, telepresence, synthetic presence, virtual presence, social presence and ego presence—but all of these terms refer to the same phenomenon. They recommend using "telepresence" as a general term. Steuer (1992) suggests that two key technological variables help to induce a sense of telepresence: vividness and interactivity. Vividness is the sensory richness of a mediated environment, including factors such as the resolution of the screen, the depth of the colour palette, and the fidelity of the audio. Interactivity is the extent to which users can modify the form and content of a mediated environment in real time.

Like Web sites and computer games, online learning environments can incorporate elements of vividness and interactivity into their design. They can provide both rich sensory experiences and rich cognitive experiences that engage the attention of learners over time. A prime example is Second Life, a massively multiplayer online role-playing game (MMORPG) that lets players use self-created digital characters to interact with a virtual 3D environment, computer-controlled characters and other players' characters. Second Life gives educators an opportunity to develop learning activities that closely resemble real-world learning experiences. Childress and Braswell (2006) describe their experiences using Second Life to support cooperative learning activities in a postgraduate instructional technology course.

Conclusion

Learning for its own sake is typically an enjoyable experience, but the same cannot always be said of formal, institutionalised learning. As Csikszentmihalyi (2003, p. 80) observes, "the assembly-line methods commonly applied to education all too often produce neither joy nor learning."

This paper has attempted to address the issue of student boredom and disengagement by suggesting instructional design principles that may help educators make online learning more conducive to flow experiences, and hence more enjoyable and intrinsically motivating. These suggestions are a small step toward answering Norman's (1996, p. 38) question of how to marry the entertainment world's skills of presentation and engagement with the education world's skills of reflective, in-depth analysis:

> Educators know what needs to be learned; they are simply pretty bad at figuring out how to get the intense, devoted concentration required for the learning to take place. The field of entertainment knows how to create interest and excitement. It can manipulate the information and images. But it doesn't know what to teach. Perhaps we could merge these skills.

The path to such a merger can be seen in the flow experiences of Web users, game players and other recreational computer users. By creating online learning environments that are amenable to flow experiences, educators may be able to counter trends of boredom and disengagement among learners and help them to achieve positive outcomes.

References

Aboujaoude, E., Koran, L. M., Gamel, N., Large, M. D., & Serpe, R. T. (2006). Potential markers for problematic Internet use: A telephone survey of 2,513 adults. *CNS Spectrums: The International Journal of Neuropsychiatric Medicine*, *11*(10), 750–755.

Brown, E., & Cairns, P. (2004). A grounded investigation of game immersion. In *CHI 2004 Proceedings* (pp. 1297–1300). Vienna, Austria: Association for Computing Machinery.

Brown, S. W., & Boltz, M. G. (2002). Attentional processes in time perception: Effects of mental workload and event structure. *Journal of Experimental Psychology: Human Perception and Performance*, *28*(3), 600–615.

Chen, H. (2006). Flow on the net—detecting Web users' positive affects and their flow states. *Computers in Human Behavior*, *22*(2), 221–233.

Childress, M. D. & Braswell, R. (2006). Using massively multiplayer online role-playing games for online learning. *Distance Education, 27*(2), 187–196.

Chou, T., & Ting, C. (2003). The role of flow experience in cyber-game addiction. *CyberPsychology & Behavior*, *6*(6), 663–675.

Craig, S. D., Graesser, A. C., Sullins, J., & Gholson, B. (2004). Affect and learning: An exploratory look into the role of affect in learning with AutoTutor. *Journal of Educational Media*, *29*(3), 241–250.

Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety: The experience of play in work and games.* San Francisco, California: Jossey-Bass Publishers.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience.* New York: HarperPerennial.

Csikszentmihalyi, M. (1993). *The evolving self: A psychology for the third millennium.* New York: HarperPerennial.
Csikszentmihalyi, M. (1997). *Finding flow: The psychology of engagement with everyday life*. New York: Basic Books.
Csikszentmihalyi, M. (2003). *Good business: Leadership, flow, and the making of meaning.* New York: Penguin Books.
Custodero, L. A. (2002). Seeking challenge, finding skill: Flow experiences and music education. *Arts Education Policy Review*, *103*(3), 3–9.
Draper, J. V., Kaber, D. B., & Usher, H. M. (1998). Telepresence. *Human Factors*, *40*(3), 354–375.
Gaines, B. R. (1997). Knowledge management in societies of intelligent adaptive agents. *Journal of Intelligent Information Systems*, *9*, 277–298.
Gardner, H. (1999). *Intelligence reframed: Multiple intelligences for the 21st century.* New York: Basic Books.
Glaser, B. G. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory.* Mill Valley, California: Sociology Press.
Glaser, B. G. (1992). *Basics of grounded theory analysis: Emergence vs forcing.* Mill Valley, California: Sociology Press.
Glaser, B. G. (1998). *Doing grounded theory: Issues and discussions.* Mill Valley, California: Sociology Press.
Goleman, D. (1995). *Emotional intelligence: Why it can matter more than IQ.* London: Bloomsbury.
Jackson, S. A., & Csikszentmihalyi, M. (1999). *Flow in sports: The keys to optimal experiences and performances.* Champaign, Illinois: Human Kinetics.
Kahneman, D. (1973). *Attention and effort.* Englewood Cliffs, New Jersey: Prentice-Hall.
Lefevre, J. (1988). Flow and the quality of experience during work and leisure. In M. Csikszentmihalyi & I. S. Csikszentmihalyi (Eds.), *Optimal experience: Psychological studies of flow in consciousness* (pp. 307−318). Cambridge: Cambridge University Press.
Nakamura, J. (1988). Optimal experience and the uses of talent. In M. Csikszentmihalyi & I. S. Csikszentmihalyi (Eds.), *Optimal experience: Psychological studies of flow in consciousness* (pp. 319−326). Cambridge: Cambridge University Press.
Newmann, F. M., & Wehlage, G. G. (1993). Five standards of authentic instruction. *Educational Leadership*, *50*(7), 8–12.
Ng, B. D., & Wiemer-Hastings, P. (2005). Addiction to the Internet and online gaming. *CyberPsychology & Behavior*, *8*(2), 110–113.
Norman, D. A. (1996). Optimal flow. *Arts Education Policy Review*, *97*(4), 35–38.
Pace, S. (2004). A grounded theory of the flow experiences of Web users. *International Journal of Human-Computer Studies*, *60*(3), 327–363.
Reisetter, M. & Boris, G. (2004). What works: Student perceptions of effective elements in online learning. *Quarterly Review of Distance Education*, *5*(4), 277–291.
Rule, A. (2006). Editorial: The components of authentic learning. *Journal of Authentic Learning*, *3*(1), 1–10.
Savery, J. R., & Duffy, T. M. (2001). *Problem based learning: An instructional Model and its Constructivist Framework*. CRLT Technical Report No. 16-01. Bloomington, Indiana: Center for Research in Learning and Technology, Indiana University.
Steuer, J. (1992). Defining virtual reality: Dimensions determining telepresence. *Journal of Communication*, *42*(4), 73–93.
Sweetser, P., & Wyeth, P. (2005). GameFlow: A model for evaluating player enjoyment in games. *Computers in Entertainment*, *3*(3).

Yair, G. (2000). Reforming motivation: How the structure of instruction affects students' learning experiences. *British Educational Research Journal*, *26*(2), 191–210.

Yee, N. (2004). Hours of play per week. *The Daedalus Project*, *2*(1). Retrieved November 26, 2006, from http://www.nickyee.com/daedalus/archives/000758.php